THE UNIVERSITY *of* EDINBURGH

The Power of the Informal

Smallholder charcoal production in Mozambique

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Declaration

I declare this thesis has been composed entirely by myself and except where otherwise acknowledged, the work presented is entirely my own. It has not been submitted, either in whole or in part, for any previous degree or qualification.

Daniel Jones, 24th of June 2016

Abstract

The charcoal market in Africa is an informal economy. This enables millions of people to earn a living producing, selling and trading charcoal, due to low barriers to market entry. However, research and policy on charcoal has long focused on the downsides of informality. Informal charcoal production is commonly linked to criminality, an undermining of social cohesion, poor working conditions and most of all, forest loss. These negative perspectives continue to shape our approaches to charcoal markets, despite a recent reframing of charcoal as a potential sustainable development opportunity.

This thesis aims to provide an alternative perspective. I argue that by focusing on the negative aspects of charcoal production, in particular forest loss, we end up misdiagnosing the problems and excluding stakeholders. The focus on forest loss has obscured research on the role of charcoal in rural livelihoods and has led to research that is primarily interested in large-scale production providing charcoal to major urban areas. This means small-scale charcoal production has been comparatively neglected in academic research, despite its importance for rural livelihoods and overall charcoal supply. Through three empirical chapters, I provide perspectives on small-scale charcoal production, its role in rural livelihoods and some of the factors that shape this role. I strive to provide novel analytical insights by moving away from questions of charcoal's environmental impact and towards an approach that situates charcoal within the politics of rural livelihoods.

I explore these ideas using case studies from Mozambique and a mixed methods approach. The results show small-scale charcoal production is a flexible form of income, primarily used as a livelihood diversification strategy. Furthermore, charcoal production is closely linked to the agricultural practices of producers. This means that conventional theoretical approaches to forest loss that treat charcoal production as distinct from agricultural practice may misinterpret the role of charcoal production in deforestation and forest degradation. I then move on to look at approaches to charcoal market formalisation in Mozambique. The results show that the regulations, whilst shaped by a variety of processes, concentrate on governing charcoal as an environmental problem. Changes to forest management requirements within the regulations have done little to improve

sustainability as they are incapable of reaching out to small producers, in part due to inherent barriers within the formalisation process - stringent forest management plans and a conceptualisation of charcoal as a full-time, professional livelihood.

The picture of charcoal production that emerges from the thesis is one of a flexible cash-income generating strategy, complicated by the politics of forest loss and livelihoods at local and national levels. The results show that charcoal plays a vital role in rural economies, not only in spite of its informality, but because of it. I argue throughout the thesis that small-scale charcoal production should be seen as a livelihood strategy to be nurtured rather than neglected and marginalised. The research questions whether the formalisation and modernisation of charcoal markets can engage small producers and concludes that in order to allow charcoal livelihoods to flourish and to improve sustainability, interventions need to work with, and for, charcoal as an informal economy.

Lay summary

Every day, tens of millions of people in urban Africa eat a meal cooked with charcoal. This simple act has been linked to forest loss for decades, meaning that our engagement with charcoal markets is shaped mainly by our environmental concerns.

Charcoal is an informal economy – the majority of the market in Africa works outside (or alongside) existing government regulation. This enables millions of people to earn a living producing, selling and trading charcoal, as getting involved in the market is cheap and easy. However, research and policy has long focused on the downsides of market informality. For example, informal charcoal production is commonly linked to criminality, poor working conditions and environmental destruction. For most, the common conclusion is that more of the market needs to be better regulated.

Throughout this thesis, I argue that by focusing on the negative aspects of charcoal production, we end up misdiagnosing the problem, marginalising small producers and discounting alternative approaches. I conclude that in order to allow charcoal livelihoods to flourish and to improve sustainable development interventions we need to work with, and for, charcoal as an informal economy.

This argument is elaborated using examples from Mozambique. Over three empirical chapters I explore: 1) the role of charcoal production in the livelihoods of smallholders in the centre of the country, 2) the links between charcoal production and agriculture in the lives of smallholders and what this means for understanding deforestation, 3) how the regulation of charcoal in Mozambique is shaped by environmental goals and the consequences of this for small producers.

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PhD to come and see you (Will, Tom I am thinking of you) - the next round is on me.

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"Always watch where you are going. Otherwise, you may step on a piece of the forest that was left out by mistake."

- Winnie the Pooh

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Abbreviations and acronyms

AfDB	African Development Bank
AMOMA	Associação Moçambicana de Operadores da Madeira
BTG	Biomass Technology Group
DDA	Departamento Distrital de Agricultura
DNFFB	Direcção Nacional de Florestas e Fauna Bravia
DPA	Direcção Provincial de Agricultura
DUAT	Direito do Uso e Aproveitamento da Terra
FAO	Food and Agriculture Organisation of the United Nations
FRELIMO	Frente de Libertação de Moçambique
IIAM	Instituto de Investigação Agraria
INAM	Instituto Nacional de Meteorologia.
IMF	International Monetary Fund
INE	Instituto Nacional de Estatistica
ILO	International Labour Organisation
MICOA	Ministério da Planificação e Desenvolvimento
MZN	Mozambican Metical
NERC	National Environmental Research Council
REDD+	Reducing Emissions from Deforestation and forest Degradation
RENAMO	Resistência Nacional Moçambicana
SEI	Stockholm Environment Institute
SPFFB	Serviços Províncias de Florestas e Fauna Bravia
UNICEF	United Nations Children's Fund
ZANLA	Zimbabwean African National Liberation Army

Chapter one

Introduction

1 Introduction

Every day, tens of millions of people in urban Africa eat a meal cooked with charcoal. Charcoal is the principal energy source for urban households on the continent (Sander et al. 2013; IEA 2014) and its use and production continues to rise (Bailis et al. 2005; IEA 2014). This makes charcoal big business. In 2012, 36 million tonnes of charcoal with a market value of around $11 billion was produced to fulfil this growing demand (IEA 2014). In some areas, this makes charcoal's importance to rural economies comparable to cash cropping (Matly 2000). The vast majority of this market is informal (Wood & Garside 2014; Del Gatto 2003; Zulu 2010; Kambewa et al. 2007), making it an important source of easily-accessible livelihoods for millions of people (Arnold et al. 2006; Zulu & Richardson 2013).

This emphasis on livelihoods is still comparatively new. Like many informal markets, the negative impacts and connotations linked to charcoal have shaped research, policy and interventions (Mwampamba et al. 2013). In particular, sub-Saharan Africa's reliance on wood energy has fuelled concerns about deforestation and degradation since colonial times (Grove 1996; Ribot 1999), worries that culminated in the "woodfuel crisis" narratives of the 1970s and 1980s. "Cold hearths and barren slopes" (Agarwal 1986) were predicted across the global South as fuel scarcity would affect billions across swathes of the continent (e.g. FAO (1981); De Montalembert & Clement (1983)). These narratives were coupled with rising concern about the health risks of burning firewood in homes and its gendered impact (Smith 2006). Woodfuel was considered an anachronism, a relic of under-development; something to be replaced (Cline-Cole 2007). Technologically innovative stoves, alternative fuels and sustainably managed woodfuel plantations were touted as the solution (Agarwal 1986; Nash & Luttrell 2006). But the crisis narrative began to unravel as researchers documented misunderstandings about how woodfuel markets respond to scarcity and the complex way households use energy (Hiemstra-van der Horst & Hovorka 2009; Leach & Mearns 1988). Forty years on, the success of cookstove initiatives is patchy (Simon et al. 2014), charcoal still dominates urban fuel consumption (SEI 2002) and woodfuel plantations have not been successful (Martins 2014). Today, woodfuels continue to be associated with health risks (Bailis et al. 2005),

illegality (Cavanagh et al. 2015), anthropogenic greenhouse gas emissions (Masera et al. 2015) and the depletion of forest[1] resources (SEI 2002). Despite the fading of the woodfuel crisis, these concerns continue to shape research and policy on charcoal production today.

Over the past decade academics, NGOs and policy makers have begun to tentatively reposition woodfuels (particularly charcoal) as a sustainable development opportunity, uniquely positioned to contribute to poverty and energy development goals (Schure 2014; Arnold et al. 2006; Zulu & Richardson 2013). Woodfuels are, depending on the context of their production, a renewable resource (Bailis 2009). Thus woodfuel markets could represent an opportunity to contribute to rural development, ease a transition towards a green economy and continue to meet growing urban energy needs. Internationally, such a framing has stirred interest in how woodfuels could contribute to climate goals, through changes in forest management practices and charcoal markets (Schure, Dkamela, et al. 2014; Neufeldt et al. 2015; Iiyama et al. 2014). Across sub-Saharan Africa, these themes are encouraging increasing interest in woodfuel issues after decades of policy neglect (Wood & Garside 2014; Schure, Dkamela, et al. 2014). Rather than ignored as un-desirable and un-modern, current engagement with charcoal ranges from the pragmatic acknowledgement of its importance to rural economies, to optimistic visions of a modern biomass energy future.

However, there are significant challenges to engaging with the diverse outcomes of charcoal markets (Schure et al. 2013). Foremost, the informal character of the charcoal market is seen as a barrier to sustainable development (FAO 2007; Owen et al. 2013). Therefore the formalisation of charcoal markets is frequently seen as key to managing woodfuel outcomes (Owen et al. 2013; Sander et al. 2013; Neufeldt et al. 2015; Schure, Dkamela, et al. 2014; Arnold et al. 2006). But, as formalisation has been applied as a development approach within a variety of natural resource management settings, studies have begun to document its mixed and often adverse impacts. In particular, poorer and smaller-scale resource users are disproportionately affected by formalisation policies,

[1] Throughout the thesis I use the term forest to encompass both “woodlands” and “forests”, akin to the FAO's (2000) definition of an area of at least 0.5 hectare with a tree canopy cover of over 10%.

leading to the benefits of formalisation being unevenly distributed (Cousins 2009; Spiegel 2012). For charcoal markets this creates an important friction: the informality of charcoal production enables livelihoods, yet is also framed as the key obstacle to sustainability. In this thesis I set out to explore this friction.

2 Analytical approach

Interest in woodfuels from both a socio-economic and environmental perspective is a relatively recent development and important gaps remain in our knowledge. There is currently little consensus on how to produce analyses that speak to both these aspects of charcoal markets. Therefore, in this thesis I draw on the broader literatures on non-timber forest products (NTFP) and the formalisation of natural resource governance, in order to provide novel insights.

Woodfuel and NTFP[2] debates have largely been separate since the 1970s (Schure 2014). This is partly because the emphasis on the environmental impact of woodfuels was at odds with initial conceptions of NTFPs as offering potential for forest conservation. Early promoters of NTFPs argued that their extraction was naturally more benign than that of timber (Myers 1988) and that they could add value to forest areas, encouraging forest conservation (Arnold & Perez 2001). This perception has shifted somewhat in recent years, and research now emphasises that the outcomes are contingent on a variety of market processes (Ingram 2014). The initial enthusiasm has given way to pragmatism – trade-offs between environmental and livelihood goals are inevitable (Kusters et al. 2006; Arnold & Perez 2001).

As debates on woodfuels and NTFPs have begun to converge around the complexities of tying sustainable management to pro-poor rural development, the literatures have created interesting points of engagement. Given that livelihood approaches to woodfuels are still in their infancy, this study follows Schure (2014) in applying analytical insights from NTFP studies to charcoal markets. The contextualised perspectives offered by the NTFP

[2] The FAO also promoted the use of "non-wood forest products" (NWFP) for a time, a definition that more explicitly excludes woodfuels (FAO 1999). This division was ostensibly for internal bureaucratic reasons (Belcher 2003).

literature can be particularly beneficial for research and practice related to woodfuels, which has tended to privilege insights derived from generic and stylised depictions of woodfuel systems, rather than the complexities and dynamics of actual woodfuel markets (Cline-Cole & Maconachie 2016).

2.1 Charcoal markets and rural livelihoods: Using insights from NTFPs

In sub-Saharan Africa, forest and woodland ecosystems are mainly managed and harvested by small farmers (Tieguhong & Schure 2015). Farmers protect valuable species within forests, domesticate others on farmland, coppice, mulch leaves, harvest trees and benefit from tree products such as wood, fruit and associated fauna. As rural areas become exposed to markets for NTFPs and charcoal, these products provide opportunities for generating income for rural smallholders (Shackleton et al. 2007). NTFPs are considered to be a particularly important and attractive income source for the resource poor (Ingram 2014). Low technical and financial entry requirements combined with the freely accessible nature of the resource enables forest products to provide cash in times of need (Neumann & Hirsch 2000). However, it is sometimes argued that these very same characteristics make NTFP activities economically inferior, with low returns, little opportunity for accumulating assets and arduous, undesirable labour requirements (Angelsen & Wunder 2003). These contrasting ideas are mirrored within the literature on charcoal production (Cerutti et al. 2015).

Insights into the varying roles that NTFP take within livelihoods can indicate environmental and developmental outcomes – an observation not fully utilised within the literature on charcoal. The roles that forest products take have three key forms: subsistence strategies, where products are harvested for subsistence use; specialised strategies where the product is the key source of income for the producer, and; diversity strategies, where the resource is used as a supplementary or additional source of income alongside other activities (Ruiz-Pérez et al. 2004). Broader diversification and specialisation strategies can take on several inflections: safety-nets which reduce vulnerability to risk by providing income at times of crisis (Shackleton et al. 2011), gap-filling where income is used to spread income (Paumgarten 2005), and as stepping-stones which households use to reduce poverty (Schreckenberg et al. 2006). Within the NTFP literature, as participants

become more integrated within the market, it is thought to lead to more specialisation of income generating activities (Ros-Tonen & Wiersum 2005). But NTFP livelihoods tend not to exist in isolation and thus the links between NTFP and other forest livelihoods (such as charcoal production) and agricultural livelihoods are (re-)gaining prominence on the research agenda (Tieguhong & Schure 2015). Such a focus has led to calls for end to the analytical separation of agriculture and forestry (Macqueen et al. 2014) – an idea which is built on in chapter three.

2.1.1 *Understanding outcomes: Livelihoods*

The roles that NTFPs and charcoal take within livelihoods cannot be divorced from the socio-economic context of their production. Across Africa, the majority of trade in NTFPs and charcoal is informal, lacking legal recognition (Ingram et al. 2014). The pro-poor qualities of NTFP and other informal livelihoods such as artisanal small mining are increasingly seen as being closely linked to the character of the informal markets (Ingram 2014). But opinions on informality are deeply divided. On one hand, some observers see informality as a "legitimate subsistence strategy of the economically oppressed" (Putzel et al. 2015, p. 457). Whereas on the other hand, informality is still widely seen as a barrier to sustainability and rural economic development (Hoare 2016).

Over the past three decades, reforms in developing countries have tried to create, strengthen and codify rights to trade, access and own natural resources as a mechanism for reducing environmental degradation and poverty. This replacing of informal ownership, access and economies through state recognition of "rights and conditions of access" (Hall et al. 2011) or the codification of informal rules and practices (Pacheco et al. 2008) is called formalisation. Across Africa this process is more advanced in some resource sectors than others. Whilst historically charcoal has been neglected by policy makers in sub-Saharan Africa (Zulu 2010; Ribot 1999), a recent upsurge in interest is currently driving reforms and interventions into charcoal markets (Schure et al. 2013; Sander et al. 2013).

Rights however - whether formal or informal - do not always translate into benefits (Ribot & Peluso 2003; Hall et al. 2011; Myers 1994). A key theoretical lens for viewing the differential outcomes of "rights based approaches" to resource management is "access".

Defined as the "ability to benefit from things", access is controlled and maintained through social and structural means such as rights, authority, knowledge, social identity and markets (Ribot & Peluso 2003; Ribot 1998). One actor's access, can be another's exclusion; thus Hall et al. (2011) invert the analysis to emphasise the "ways in which people are prevented from benefiting from things" (p. 7) through the powers of regulation, market, force and legitimation. Formal and informal institutions[3] have a mediating role in resource access (Ribot & Peluso 2003; Leach et al. 1999) and can act to exclude. In countries characterised by legal pluralism, a variety of formal and informal institutions (for example: states, local state authorities, customary/traditional authorities etc.) recognize claims to use and benefit. These overlapping institutions can try to solidify and foster legitimacy through the recognition of claims to resources. Therefore, struggles over claims to use and benefit from resources are as much about institutions vying for legitimacy as they are about access to resources (Sikor & Lund 2009).

The ways in which access influences how benefits are distributed within charcoal markets has been increasingly documented. Generally, studies on major commodity chains leading to primary cities have shown that rural producers struggle to capture the lucrative benefits of the charcoal industry (Ribot 1993; Kambewa et al. 2007; Sander et al. 2013). Traders and transporters on the other hand tend to profit, either due to their ability to mobilise capital to increase their traded volumes (Brouwer & Magane 1999) or through maintaining access through informal relationships alongside the formal regulation (Ribot 1998). The role of institutions within these processes still however remains a research gap (Schure 2014).

As the livelihood and poverty reduction benefits of charcoal production are increasingly touted, interventions aim to restructure charcoal regulation through formalisation (Zulu & Richardson 2013; Schure, Levang, et al. 2014). Understanding the flux of access and exclusion and how formal (and informal) institutions contribute is therefore important (Ribot 1998; Schure et al. 2013). In other natural resource settings in which formalisation

[3] Definition: Regularized patterns of behaviour between actors in society that shape access, rights and obligations related to charcoal production and trade" (Schure et al. 2013; Leach et al. 1999). Formal institutions (such as the rule of law) require the enforcement by an external actor. Informal institutions rest on mutual agreement amongst those involved or by power relations between involved actors.

policies have been enacted, the outcomes have been mixed. Well-meaning interventions, on paper equitable, can have unforeseen consequences precisely because they fail to conceptualise resource users as being constrained (Ribot 2010). Case-studies from a variety of natural resource settings show that small producers particularly struggle to benefit from the restructuring of regulation (Ribot et al. 2010; Putzel et al. 2015; Spiegel 2012).

2.1.1.1 *Research gap: Understanding outcomes for small producers*

After decades of policy neglect, increasing interest in charcoal markets as a sustainable development opportunity is leading to the restructuring of charcoal market regulation in many African countries (Schure et al. 2013). Yet the outcomes of such formalisation policies for small producers are increasingly questioned in a variety of other natural resource management contexts (Spiegel 2012). Thus understanding how informality contributes to charcoal livelihoods and how formalisation policies shape such outcomes constitutes an important research gap.

Research on charcoal production has tended to focus on specialised production, primarily by professional producers. It has also mainly engaged with their impact on forests, rather than their livelihoods. Whilst there is an acknowledgement that charcoal production takes a variety of roles within producer's livelihoods, what shapes this role for small-scale[4], unspecialised producers remains understudied. Small scale charcoal production makes up a considerable proportion of the total supply across Africa (Schure 2014; Kambewa et al. 2007; Ainembabazi et al. 2013) and in terms of actors involved, represents the largest stakeholder group (Kambewa et al. 2007; Kinyanjui 1987). The importance of small-scale producers within major supply chains cannot be understated. By way of example, research from Malawi estimates that for a medium-sized city (Zomba, approx. 100,000) that 75% of producers are "small-scale", producing less than 30 bags a month (Kambewa et al. 2007). Such producers contribute around 40% of the total charcoal supply (Ibid.). A lack

[4] Within the literature on artisanal mining, small forest enterprises and charcoal production, there is no single definition of "small-scale" or "small producer". Here, I characterise charcoal "small-scale" or "smallholder" charcoal production as production undertaken without a patron backer, predominantly using traditional or artisanal methods. It can be undertaken by individuals, households or small groups of people. Production by small-groups excludes situations where the majority of producers are employed full-time in charcoal production.

of case studies of small scale and smallholder charcoal production restricts deeper understanding of the role which charcoal takes within the livelihoods of these producers.

Finally and more generally, forest policies and laws do not adequately account for those mixing forest and farm activities (Macqueen et al. 2015). Whilst smallholders may have rights to the land and to clear the land, the regulation does not account for smallholder management of forest resources. How regulation can act to exclude small producers is beginning to be documented within research on other natural resources (Spiegel 2012). But there is a lack of similar case-studies on how small-scale, artisanal charcoal producers are affected by similar processes. Thus, this thesis also sets out to look at how charcoal market formalisation impacts small-scale producers.

2.1.2 *Understanding outcomes: Forests*

The impact of charcoal markets on forests has dominated research on charcoal production and continues to shape our academic and policy engagement today (Leach & Mearns 1988; Ribot 1999; Arnold et al. 2006; Mwampamba et al. 2013). In recent years, discourses on forestry, climate change, modernisation and energy scarcity have been mobilised to re-frame charcoal as a sustainable development opportunity (Cline-Cole 2007), emphasising its potential as a renewable, sustainable energy source under the right conditions (Cline-Cole 2007; Zulu 2010; Schure, Dkamela, et al. 2014; Arnold et al. 2006). Thus the reforming of charcoal legislation across sub-Saharan Africa aims to reduce forest loss through stipulating sustainable harvesting practices (NL Agency 2010; Arnold et al. 2006; Schure et al. 2013).

Although the dominant narrative frames charcoal production as an important driver of forest loss[5], charcoal's impact on forests has been continuously contested over the past three decades. Understanding charcoal's role in deforestation is complicated. As the literature on deforestation has tried to bridge the gap between "single factor causation and irreducible complexity" (Geist & Lambin 2002), approaches that attribute causality to

[5] Throughout this thesis I refer to forest loss to describe a reduction in woody biomass. The term encompasses both deforestation and degradation. Whilst technically more precise, I avoid the use of "woody biomass loss" as it foregrounds biomass and is therefore, for my tastes, overly suggestive of carbon forestry and linked climate change issues.

individual proximate drivers of forest loss have arisen. Attributing forest loss events to drivers is not straightforward (see chapter three) and neither is scaling findings to describe and explain regional processes (Ryan et al. 2014; Mertz et al. 2012). Thus most attempts at understanding charcoal induced forest loss rely on best-estimates, idealised depictions of market function and extrapolating demand to model a hypothetical area of deforestation (LTSi 2015).

Despite the difficulties in quantification, charcoal's overall contribution to forest loss in Africa has been re-assessed over recent years. Charcoal production is estimated to account for 14.07 ± 5.27% of sub-Saharan Africa's total deforestation (Chidumayo & Gumbo 2013). Other models estimate the proportion of the woodfuel supply made from non-renewable biomass between 30.1-40.6% (Bailis et al. 2015). These findings are substantially lower than common perceptions of charcoal's impacts on forests (Ibid.). Nationally, there is sufficient woody biomass to meet demand in the vast majority of sub-Saharan African countries (Bailis et al. 2015). However, there is a general consensus that concentrated demand for charcoal around urban areas constitutes a significant pressure on peri-urban forest resources (Bailis et al. 2015; Drigo et al. 2008). Whether, how and where this pressure translates into forest loss is contested.

One common view is that the development of destructive commercial extraction accelerates as peri-urban forest resources are depleted (Marufu et al. 1997; Allen 1985). This happens as producers, wholesalers and transporters minimise costs and increase production by introducing credit agreements, chainsaws and larger trucks (Arayal 1999). A contrasting view is that commercialisation is less a function of economic scarcity and more of a result of livelihood specialisation (Dewees 1989). In such a scenario the livelihoods of specialised producers are dependent on the continued availability of tree resources (Foley 2001) which provides an economic incentive for their sustainable management (Hiemstra-van der Horst & Hovorka 2009).

Therefore, a common thread within the charcoal literature compares and contrasts mobile specialised producers, with specialised "local" residents, arguing that mobile producers have fewer incentives to sustainably manage production areas (World Bank 2010). However, this too is contested. Preferences for certain species, flexible transport

arrangements, labour considerations and the local politics of resource access can combine to lead to more sustainable patterns of harvesting (Cline-Cole 1998; Ribot 1999; Foley 2001). These researchers point to case study evidence that suggests that sourcing patterns in urban woodfuel markets in African dry woodlands do adapt to localised shortages and are highly dynamic (Cline-Cole et al. 1990; Hiemstra-van der Horst & Hovorka 2009; Hansfort & Mertz 2011; Foley 2001).

2.1.2.1 *Research gap: Understanding the link between charcoal, agriculture and forest loss*

The impact of charcoal production on forest resources is clearly context specific (Nash & Luttrell 2006; Cline-Cole & Maconachie 2016). Therefore, our lack of understanding of the role of non-specialised charcoal production within rural livelihoods leaves a gap in our knowledge about charcoal induced forest loss.

Questions about how charcoal market demand translates into forest loss are usually phrased in terms of market function, but market function is ultimately a result of the role that forest products take within rural livelihoods (Ruiz-Pérez et al. 2004). As seen in the NTFP literature these roles are varied: Smallholders manage land for more than one purpose (Rasmussen & Reenberg 2015; Roth 2008) and with diversified livelihoods, unpicking why land is cleared can be difficult. By viewing forest loss through livelihood strategies and practices, this thesis can provide important insights into the factors that can shape where harvesting occurs, trajectories of change and resource dependence – contributing towards an understanding of not only forest sustainability, but of livelihoods.

This approach to forest loss cannot give a concrete answer to the impact of charcoal on forests. What it offers in its place is insights into how producers sculpt the broader socio-economic pressures contributing to forest loss, through their practices and politics. Such an analysis is particularly useful for understanding how future interventions related to charcoal could account for the multi-faceted nature of rural livelihoods. By drawing on insights from the NTFP literature on the role of forest products with rural livelihoods, this analysis can also add to debates on how charcoal contributes to rural development in diverse situations – beyond the urban fringe of major cities and beyond specialised producers. Thus, this research gap aligns with the goal of understanding small-scale

charcoal production, providing a concrete, novel and pertinent contribution to the existing literature.

2.1.3 *Summary of analytical focus*

By applying the insights from the NTFP literature and investigating the role that forest products take within livelihood strategies, this thesis hopes to contribute to better understanding of rural charcoal markets, grounding them firmly in the messy realities of charcoal's complexity. By conceptualising charcoal production from a livelihood perspective and focusing on the role of informality in facilitating this livelihood, the thesis can contribute to broader debates on the compatibility between environment and development goals within forest product markets. And by conceptualising forest loss as being a function of livelihood practices, dependent on the role of charcoal within the broader livelihood of the producer, I can offer insights into deforestation and degradation in areas where land-uses and livelihoods are mixed, overlapping and complex.

The focus on small-scale charcoal production can provide an important contribution to the literature on charcoal markets. By focusing on small producers, the research can also speak to debates about the impacts of formalisation policies on small resource users, as well as to discussions on informal livelihoods. Given the current trends within charcoal market interventions (and their environmental preoccupations) and debates on the importance of informality for small/artisanal resource users, this thesis can provide a timely and important perspective.

2.2 Research aims

This thesis therefore has three key aims. The first aim is to understand the role of charcoal production in the livelihoods of small producers. The second aim is to build on this understanding and explore ideas about how small scale charcoal production links to debates on forest loss. Finally, the third aim is to investigate how market formalisation shapes outcomes for small producers. Based on these aims, the following questions guide this thesis:

1) What is the role of charcoal production within small-producer's livelihoods?
2) What are the implications of the role of charcoal production within small

producers' livelihoods for understanding forest loss?

3) What is the relationship between informality/formality and small-scale charcoal producers' livelihoods?

3 Research design

Given the sparse empirical base on small-scale charcoal production, throughout this thesis I develop a case study of small producers in Mozambique. In order to address the third research question on informality/formalisation within charcoal markets, I broaden the analysis to include a second case study. Before outlining the specifics of these cases, in this section I provide relevant context for understanding Mozambique's charcoal market. I then introduce and justify the cases, and provide an overview of the methodological approach. The section ends with an outline of the empirical chapters which follow.

3.1 Mozambique

At independence in 1975 Mozambique was poor, very unequal and suffering from a legacy of colonial occupation (Hanlon & Smart 2008). The situation worsened as an anti-communist political and military force (RENAMO - Resistência Nacional Moçambicana) emerged as the dwindling popularity of the liberation movement (FRELIMO - Frente de Libertação de Moçambique) converged with Rhodesian/South African finance (Vines 2013; Minter 1989). The following two decades of war severely damaged the country's socioeconomic development. Around one million people were killed by fighting or starvation and between three to five million were displaced internally and externally (Rupiya et al. 1998). The war badly damaged rural infrastructure and restricted access to rural areas (UNICEF 1989). In total the economic cost to Mozambique was estimated to be around $15 billion (Ibid.).

Following independence, there was a pulse of central planning after FRELIMO created a one-party state, although this was a piecemeal process as Mozambique retained some private businesses and institutions (Wuyts 2001). During the 1980s pressure was exerted on Mozambique to accelerate its move towards capitalism. A donor strike in 1983 helped trigger IMF and World Bank membership in the following year, a move that led to a significant increase in aid (Hanlon & Smart 2008). The initial desires of FRELIMO to keep some elements of central planning were sharply undercut by a second donor strike

in 1986 and a rapid ratcheting up of structural adjustment policies by the IMF from 1987 onwards. The policies and free-market ideology of the Bretton Woods Institutes (BWI) were the predominant shaping force of Mozambique's economy for the next decade and debates about their impact on post-war Mozambique continue (see for example Collier (2007)). Hanlon & Smart (2008) portray 1996 as the end of the "BWI hard-line", marked by some relaxation of structural adjustment policies and leading to an influx of investment and the mega-projects which shape Mozambique's macro-economy today (Cunguara 2012). The legacy of this external influence on the Mozambican state has been decidedly mixed (Wuyts 1996).

Today, behind the veil of a 7.2% economic growth rate over the past decade, poverty is still pervasive. Mega-projects, aid dependency (Castel-Branco 2008) and the linked macro-economic growth have masked rural poverty and inequality (Government of Mozambique 2004), failing to knit together other areas of the economy (Castel-branco 2004). Thus despite the rhetoric, there has been a relative lack of engagement with rural development (Harrison 2000). In short, the macro-economic growth has not been redistributed (Hammar 2012). Generally, expanding commercial agriculture and increasing smallholder incomes by improving yields are seen as the key engine for future rural development in Mozambique (Cunguara & Kelly 2009; Jones & Tarp 2012).

3.1.1 *Woodlands and rural livelihoods in Mozambique*

A large swathe of southern, central and eastern Africa is covered by miombo woodland – in total an area of 2.7million km^2 (Millington et al. 1994). Classifications vary (Ryan et al. 2012), however, in Mozambique, the miombo is commonly considered semi-arid deciduous savannah woodland (Mistry & Berardi 2006). Miombo primarily consists of the closely related genera *Brachystegia*, *Julbernardia* and *Isoberlinia*, with the Swahili word for *Brachystegia* (miombo) providing its name (Coates Palgrave et al. 2000). A variety of types of miombo are recognized making it useful to dilute the definition of miombo to include other related Southern-African woodlands. This can better represent the miombo's patchwork construction (Nelson 2012).

Miombo, mopane and related woodlands support millions of livelihoods across Mozambique (Dewees et al. 2010), dominating the country's vegetation (White 1983).

Woodland social-ecological systems across Mozambique and the broader miombo eco-region are characteriseded by comparatively high population densities, shifting cultivation and a reliance on forest products for supporting livelihoods (Shackleton & Clarke 2007). They provide the primary source of energy and subsistence goods as well as products commonly used to diversify livelihoods (Campbell et al. 2007; Shackleton et al. 2007). The woodland's role in formal and informal rural economies is also increasingly acknowledged (Jumbe et al. 2011), although historically they have not been managed for the benefit of the rural poor, due to their ecological complexity and multiple, overlapping uses (Dewees et al. 2010). For the purpose of this thesis, miombo, mopane and related woodlands are treated as being broadly comparable socio-ecological systems.

3.1.2 *Charcoal and livelihoods in Mozambique*

One of the most important livelihoods provided by woodlands and forests in Mozambique is charcoal production. Producing, selling and trading charcoal provides tens of thousands of people with work at every stage of the supply chain (van der Plas et al. 2012). Studies around Mozambique's capital Maputo have documented the substantial benefits of charcoal for producing communities (Chavana 2014; van der Plas et al. 2012; Brouwer & Magane 1999). Around half of charcoal income is captured by producers (van der Plas et al. 2012), but these benefits can be unevenly distributed between patron-backed specialised producers and resident forest communities (Ribot 1993; Luz et al. 2015).

Like other areas of sub-Saharan Africa, charcoal markets in Mozambique have long been associated with forest loss (van der Plas et al. 2012). The pressure charcoal places on forest resources is unevenly distributed across the country, and is concentrated around major cities such as Maputo, Beira and Nampula (Plas et al. 2012; Atanassov et al. 2012). The extent to which this pressure translates into deforestation is unknown and highly contextual. Empirical studies have shown decreases in woodland around major urban areas in Mozambique (Falcão 2013), however the link to charcoal production remains unclear. In one of the only quantitative estimates of charcoal's contribution to forest loss, an empirical case study in central Mozambique attributes 18±9% of biomass loss to charcoal production (Ryan et al. 2014). Charcoal is thought of as a key driver of

deforestation by the Mozambican government (Government of Mozambique 2015; Republic of Mozambique 2013).

After decades of neglect, charcoal is beginning to receive constructive policy attention (see for example: Chatham House (2015); Government of Mozambique (2015)). This attention is mirrored in other African states, many of which are pursuing charcoal market formalisation and changes to regulation (Schure et al. 2013; Sander et al. 2013; Neufeldt et al. 2015). This shared characteristic, alongside a high degree of charcoal dependency and a high degree of market informality, makes Mozambique a useful place to situate a case study. Its shared woodland ecology with its neighbours (Malawi, Tanzania and Zambia[6]) also allows further, more in-depth comparisons at the regional level.

3.2 Case study research design

In this thesis I use a case study approach to develop contextual knowledge about small-scale charcoal production. A case study is an empirical investigation of "a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident" (Yin 1994, p 13). Case studies are characterised by detailed context, multiple sources of data, mixed methods often triangulated for converging results and a study design that emerges iteratively during the research (Flyvbjerg 2006; Yin 1994).

A case study approach suited my research aims as I wished to develop in-depth knowledge on small-scale charcoal production, utilizing a variety of methods and the various perspectives they could offer. This approach helps to address the key identified research gap: a lack of knowledge on small-scale charcoal production. Furthermore, views of woodfuel markets tend towards over-generalisation and would benefit from more contextual and nuanced understandings of woodfuel issues (Cline-Cole & Maconachie 2016; Ribot 1999). A case study approach from a context outwith the existing literature can therefore provide a counterbalance and shed light on the existing literature.

Thus, at the core of this thesis is a case study from central Mozambique – Community

[6] Zimbabwe too – although Zimbabwe lacks a charcoal market.

A[7]. This case study is used in chapters two and three to answer the first and second research questions. As well as being an interesting study of context, the case is used paradigmatically (Flyvbjerg 2006) to inform the existing literature. I describe how in section 3.2.1.

In order to answer the third research question, chapter four supplements this primary case with an additional study from southern Mozambique. This makes the research design multi-scalar, as I endeavour to link the findings from central and southern Mozambique to national approaches to charcoal market regulation.

The case study focuses on charcoal production and thus whilst the findings are set within the broader context of charcoal commodity chains, the study does not investigate demand side dynamics. For both the primary and secondary case studies presented below charcoal demand has been increasing (Plas et al. 2012). The dynamics of this increase are relatively unknown, but presumed to constitute a relatively steady increase without considerable flux.

The rest of this section is structured as follows. I first present the rationales behind the two case study areas, before going on to discuss their external validity. I then discuss how I strove for internal validity of the data and summarise the methods used to collect it.

3.2.1 *Primary Case Study: Manica Province: Community A*

Manica province is situated in central Mozambique (Figure 1) and had a population of around 1.44 million in 2007 (INE 2016). Whilst the study area itself is of comparable population density to the rest of Mozambique, the broader region of the Beira Corridor has a higher population density compared to the rest of the country. (Sunderlin et al. 2008). The province is dominated by miombo woodlands, with some areas of higher biomass forest in mountainous areas (Ryan et al. 2014). The region is broadly characteristic of woodland social-ecological systems across Mozambique and the broader miombo eco-region.

As with the rest of the country, rural livelihoods are dominated by smallholder agriculture,

[7] See section 3.4 for a discussion about why I have anonymised the research communities.

with most farmers practicing variants of shifting cultivation (Jones & Tarp 2012; Sousa 1999; Pauw et al. 2012) alongside more permanent agricultural plots (Walker, 2012). As with the rest of the country fallow lengths vary considerably amongst farmers depending on purpose, soil type and agricultural demands. Households cultivate around 1.74 ± 0.51 ha (mean ± standard deviation), a figure similar to other Mozambican provinces (Pauw et al. 2012). The main crop is maize, grown for subsistence and for income, although in recent years soya has become increasingly common due to the presence of a major regional buyer (Hanlon & Smart 2014). The impacts of the mosaic of land-uses and land-cover types means that accessing trajectories of change in the woodlands is complex (Jansen et al. 2008).

Theoretically, a mild and wet climate should make agricultural conditions more favourable than in the southern provinces. This said, agricultural opportunities are broadly comparable with the rest of Mozambique. An influx of agricultural capital in the 2000s as Zimbabwean farmers migrated and outgrowing opportunities grew, led to the province being seen favourably for agricultural development (Hanlon & Smart 2014). But this promise has largely evaporated (Ibid.) and there is currently little evidence that smallholders are benefiting from regional agricultural growth initiatives (Kaarhus, 2011).

For smallholders, access to agricultural land is through traditional authorities. Whilst all land in Mozambique belongs to the state, traditional authorities are allowed to issue land to local residents (Land Law, 1997). Thus local hereditary chiefs act as the first point of contact for smallholders wishing for new land within an area. Chiefs are officially recognised within by the Mozambican state and receive some financial compensation for their work, meaning traditional authority has a complex and sometimes ambiguous relationship to the Mozambican state (Buur & Kyed, 2005). This means that occasionally smallholders can appeal to local government authorities about matters of land distribution. Community land (i.e. a chieftaincy) can be delineated through a government mapping process leading to a land use title, called a DUAT (Direito do Uso e Aproveitamento da Terra), which provides a formal legal footing for local tenure arrangements. Individuals can also apply for a DUAT although this is very uncommon for smallholders. No chieftaincy within the primary case study area yet received a DUAT.

Alongside agriculture other important rural livelihoods include charcoal production (this thesis) and artisanal small mining (Hilson 2003). NTFPs are used as part of broader diversification strategies within the study area, but there are few opportunities for commercialisation.

3.2.1.1 *Area choice*

The case study area, Community A, was chosen as it encompasses two key characteristics. The first enables the answering of research questions one and two, and the second adds further novel value to research.

Firstly, Community A contains a large number of small-scale charcoal producers. As outlined in section 2.1.1, research on charcoal production has tended to focus on specialised production and has predominantly engaged with its environmental impact, rather than the livelihoods of producers. Thus in addition to answering research question one, the case study can provide a basic empirical foundation for the exploration of the second and third research questions.

Secondly, Community A supplies charcoal to Town A, a small urban settlement of around 30,000 people. There is a lack of research about the charcoal markets of small towns and cities (Smith et al. 2015; Girard 2002), as woodfuel studies/interventions are overwhelmingly concentrated around primary cities and capitals (Levy & Kaufman 2014; Brouwer & Magane 1999; Atanassov & Mahumane 2012; Falcão 2013; Hines & Eckman 1993; Hofstad 1997; Mwampamba 2007; Gumbo et al. 2013). This is not only a research gap for now, but one which has heightened importance for the future, as 75% of Africa's future urban population growth (considered to be a key force in increasing charcoal demand) will be concentrated in urban areas with a population of less than one million (UN-Habitat 2014). Given the role of these areas in increasing charcoal consumption across sub-Saharan Africa (Girard 2002), this leaves an important research gap. Thus the case aims to produce novel, context dependent knowledge to fill this gap.

3.2.2 *Secondary case study: Gaza Province*

The secondary case study introduced in the final empirical chapter was initially researched as part of the ACES (Abrupt Changes for Ecosystem Services) project in Southern

Mozambique[8]. Primary data was collected as part of this project and supplemented by myself through follow-up interviews with key informants and local forest department officials.

Gaza presents an interesting complementary study to Manica. The north of Gaza province is one of the major supply areas for Maputo (Levy & Kaufman 2014; Chavana 2014; Atanassov et al. 2012). Production is dominated by specialised producers, both patron-backed and resident smallholders. The smallholders are of particular interest as although many specialise their livelihoods around charcoal production, most produce at a comparatively small-scale (Levy & Kaufman 2014). The case is therefore used to help link the findings about specialised small-scale charcoal production to the findings from Community A about more diversified forms of small-scale charcoal production.

The case was therefore chosen for its contrasting features (specialised production within a major charcoal supply chain) and that the research conducted within the ACES project was at a similar scale to that conducted in Community A. More details about the case are presented in chapter four.

[8] https://miomboaces.wordpress.com

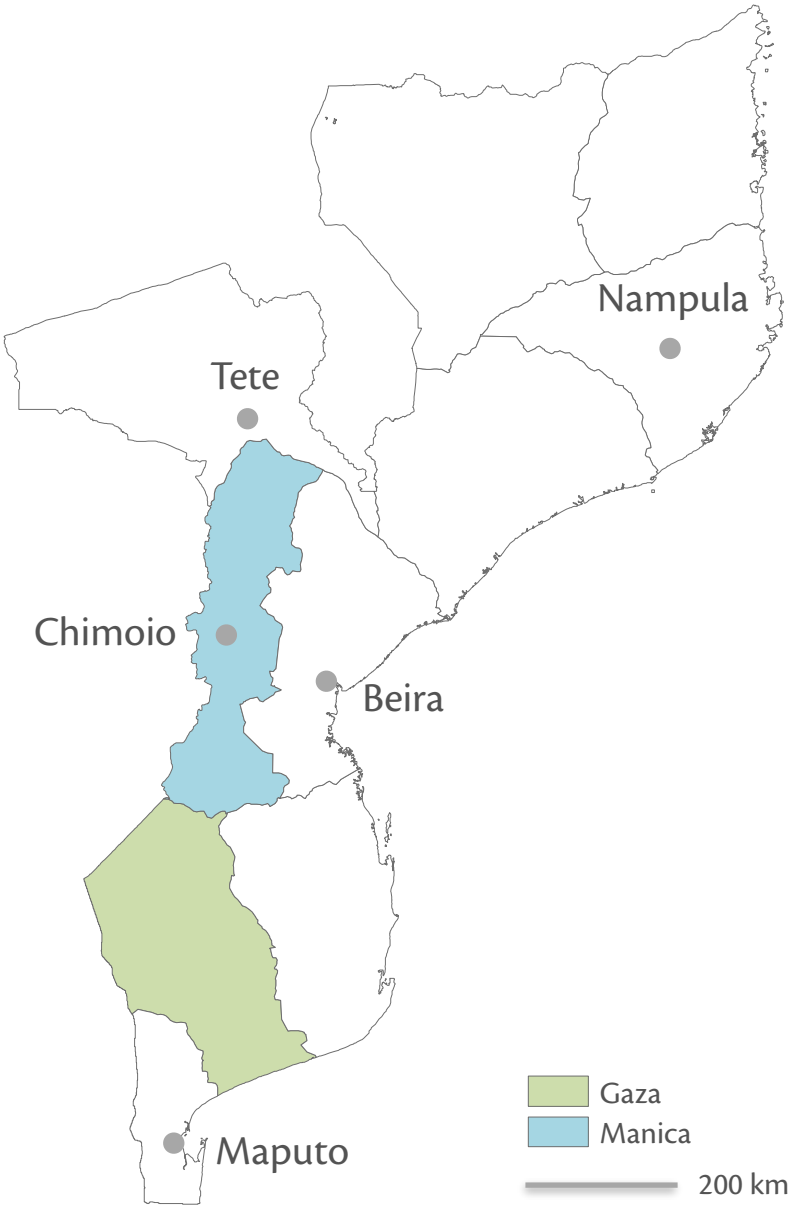

Figure 1 – Map of location of the study provinces.

3.2.3 *External validity of the findings*

Whilst both cases enable the production of important contextual knowledge, how and under what circumstances can generalisations be made and lessons be learnt from them? A common criticism levelled at case study research is that it lacks external validity. Thus in this section I outline how the cases can contribute to broader debates, beyond the local context of these specific charcoal markets. I predominantly refer to the primary case,

Community A. I deal more specifically with which findings can be generalised and under what circumstances in their respective chapters.

The extent to which small town, and small-scale charcoal production are a function of each other is difficult to fully determine, given the lack of other case studies on small towns and cities. Small-scale charcoal production, however, is a significant contributor to charcoal commodity chains across Africa (Schure, Levang, et al. 2014; Zulu 2010; Kinyanjui 1987; Meyer 2010; Kambewa et al. 2007). The case can therefore be used as a point of comparison to aid the understanding of small-scale charcoal production in other commodity chains. Whether Community A can be said to be representative of small-town charcoal production is a question that this thesis cannot answer, due to the pioneering nature of the study. Recent research on a medium size urban area (100,000 people, Zomba, Malawi), suggests that such commodity chains are less stratified, compared to larger cities, with traders not controlling the market as powerful intermediaries (Smith 2016). This characteristic is also apparent within this research, yet throughout the thesis I am cautious about extrapolating the "small-town" findings. Bearing this caveat in mind, the commodity chains followed as part of research for chapter four, do suggest that in Manica province, small-town charcoal markets are broadly similar.

Whilst the precise mode of small-scale charcoal production will clearly be context dependent, the findings of the case can be used to highlight important processes. In this sense the case can be defined as paradigmatic (Flyvbjerg 2006). Specifically, the case can serve to generate generalizable knowledge about how our engagements with charcoal markets can impact small producers. In chapter four, for example, its use alongside the Gaza case study enables the drawing of parallels across two Mozambican contexts.

3.2.4 *Improving internal validity*

This study aimed to improve its internal validity by the triangulation of data for points of convergence. Data was also triangulated for divergence. When there is a mismatch between data sets, triangulation for divergence looks not only for explanations built on the complementarity of data, but also examines the partiality of the sources of knowledge (Ahlborg & Nightingale 2012). It can show both the partiality of our methodological tools and the partiality of actors' knowledge.

Validity is also developed through consultations with peers and respondents. Preliminary results were presented to the communities involved in the research in August 2014 following fieldwork. More concrete findings were presented to Community A, local development organizations and local authorities in August 2015. Feedback from these consultations was used to refine the arguments presented in each chapter and helped shape the overall focus of this thesis. As well as contributing to the internal validity of the case studies presented, consultations also enabled further discussions about the broader, external validity of the data.

3.3 Methods

A variety of methods were used to answer the research questions. Following the identification of a suitable case study area, the empirical research was organized into two phases: one exploratory, and one more focused. In the exploratory phase, issues surrounding charcoal markets and smallholder livelihoods in Mozambique were investigated using ethnographic and qualitative methods. This provided the groundwork for developing the quantitative survey, which was the basis for understanding the prevalence of charcoal production and its role in livelihoods within the study area.

The empirical chapters which follow provide detailed information on methodologies used for data collection and analysis. For clarity, this section presents a general overview of the methods applied as well as an overview of the fieldwork structure. Figure two shows the methodological "flow" of the study and the constituent parts of the field work.

A summary of the methods used is as follows:

Literature reviews and document analysis

This secondary research covered both the scientific literature and the technical/project literature on woodfuel issues. This provided information about charcoal regulation, institutional arrangements, project and policy interventions as well as the context surrounding charcoal production in Mozambique. In chapter four, price data obtained through archival research of national newspapers is also used.

Interviews

Both semi-structured and unstructured interviews were conducted with stakeholders and actors from both within the charcoal market and within industries surrounding it (biofuels, energy and development, forestry sector etc.). These provided information about the roles, politics and motivations of actors within the charcoal market as well as documenting patterns and rhythms of change. Interviews with producers also determined the role and function of charcoal in their livelihoods. Appendix B, provides an example of an interview template used with charcoal producing households. Alongside semi-structured and unstructured interviews, two other forms of interviews were used: 1) Narrative interviews, which aim to encourage interviewees to talk about events in the form of a story, or life history (Bauer, 1996); And 2) "Mapping interviews", where in addition to a standard semi-structured interview, the land uses within a smallholding were outlined using a GPS. Interviews within Community A were conducted by myself in English and Portuguese (in later stages of the PhD), and through an interpreter in chiManyika, chiShona, chiNdau and chiTewe. In early stages of the research I was particularly reliant on my interpreter as my guide to the politics, customs and practices of community A. In addition to my own positionality (see the section on ethnography) I had to also reflect continuously on his positon within the community and the way that this shaped early research experiences in the field (see Nelson 2013 for a good discussion of field assistant relationships and research).

Interviews are referenced to tables in Appendix A and take the form of a two letter code and a number, for example: CA-1. This code indicates the particular table and interview number.

Focus groups

One participatory rural appraisal focusing on livelihoods in Community A was conducted to cross-reference interview findings and help develop the focus of the other methods. This appraisal was conducted together with a local charity with my research interests added to an existing appraisal format. For the charity, the PRA was part of an ongoing process of developing a small agricultural co-operative within the study area. For myself, the PRA represented an opportunity to gain basic information about the study area and key issues relating to woodlands, woodfuels and livelihoods within a group setting. Thus

whilst the PRA was primarily a data extraction exercise for myself, it actually constituted one step in a series for the charity and community. In this way I avoided common pitfalls attributed to "participatory" research models. The PRA was conducted with a mixed gender group of farmers who had just begun to engage in a soya project with the charity (n=24). Exercises ranged from community mapping, basic wealth ranking and discussion groups. Questions for the discussion groups included those related to my research objectives: charcoal, agriculture and the local woodlands.

In addition to the PRA a focus group was conducted on charcoal production in Community A in order to develop categorisations of production situations for the household survey (see chapter two). This focus group consisted of a subset of the same participants of the PRA (although was conducted at a later date) alongside additional charcoal producers (n=7), invited to create a better balance of producing and non-producing participants (n=5).

Ethnographic field work

Ethnographic fieldwork was used in the exploratory phase of the study to understand the function of the market, the roles of charcoal within rural livelihoods and develop themes for further analysis. Initially, this entailed living within the community and helping out with charcoal kilns and agricultural tasks. In the field the boundary between "hanging around" and "doing research" (Jenkins, 2011), meant thoughtful and reflective observation and actively seeking out tasks relevant to the research at hand. This reflection involves stepping back from both the context of the research and the act of researching (Jenkins, 2011; Bordieu 1977). In short, my research interests, my attitudes and (my)self influenced the research and those I was working with. And inevitably, who I built relationships with affected who I could subsequently build relationships with. Thus my account is by necessity partial. Despite these caveats, the ability to (with care) speak from direct experience and be flexible enough to develop research that is of local interest makes ethnography a powerful approach. So whilst objectivity appeared at times rather elusive throughout the fieldwork, the benefits outweigh the caveats it entails. Vitally for this research, the ethnographic work involved living in the study communities for longer periods of time and therefore enabled insights into charcoal as an informal livelihood.

The fuzzy legality of charcoal production makes its research difficult, with producers frequently nervous to the intentions of outsiders. My longer term presence within the study community reduced these concerns and my willingness to lug around sacks of charcoal proved a powerful way of initiating interesting conversations.

Commodity chain analysis

Throughout the thesis I rely on contextual information obtained through basic commodity chain analyses. In this "basic" commodity chain analysis, the flow of charcoal from rural to urban areas and the various relationships between stakeholders were mapped and interviews conducted with participants. The analysis was mainly a tool for following the product and organising interviewing. Thus the analysis did not entail the collection of extensive horizontal or vertical income data, but did outline market access for stakeholders at each level. The data is primarily used contextually throughout the thesis, or to inform sampling strategies, site selections or the data's external validity.

Commodity chain analyses were carried out for three small district capitals in Manica province. These are referred to as Town A, Town B and Town C. In addition, a commodity chain analysis was conducted for Chimoio, the provincial capital. Commodity chain interviews relating to Town B and Chimoio were conducted with students from the English Club of Chimoio, who received training in qualitative research methods and interview techniques and helped shaped the outline of the basic interview. Interviews from the commodity chain analysis are cited with the code "CC".

Quantitative household survey

A sample survey was conducted with charcoal producers to obtain information about the prevalence of charcoal production and socio-economic data about livelihoods amongst producers and non-producers in the study area. The methodology for the survey is more thoroughly detailed in chapter two and the questionnaire form is included in Appendix C. Throughout the quantitative field survey myself, five graduates (three men, two women) from the local forestry and agricultural college and a local cook lived and worked together in community A. As well as acting as enumerators for the household survey the research team were encouraged to pursue their own research interests related to the research topic. This collaboration enabled additional insights into charcoal, particularly

in relation to gender. Again, the presence of extra "outsiders" presented certain challenges in terms of positionality and community relations. Whilst my presence was known, their arrival on one occasion led to a very angry response from one household (before clarification). The team were however incredibly good at reflecting on the intricacies of local community relations, allowing us to develop a reflective[9] and effective research approach.

Analysis of secondary data

Charcoal licensing data is used throughout the thesis and was provided by provincial and district forestry departments for both the primary and secondary case study areas. Additional information on its scope and use is covered in chapters two and four. This provides data on the nature and characteristics of formal charcoal production.

[9] By way of example, one of the most interesting conversations throughout the fieldwork related to how the choice of traditional local dress or smart city skirts affected the perception of the female research team.

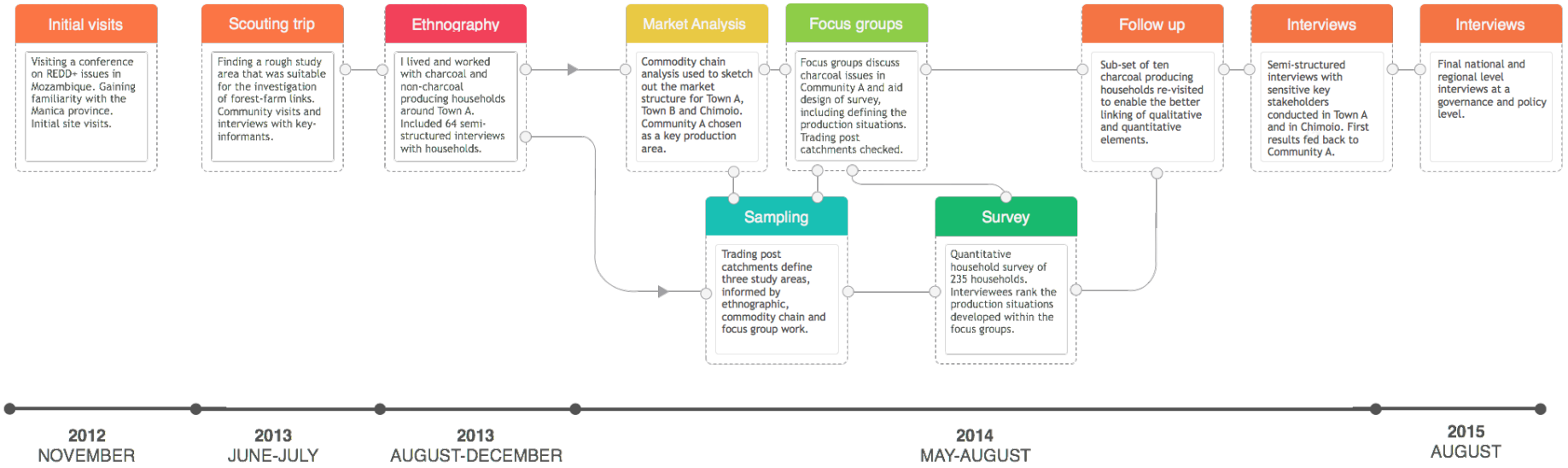

Figure 2 – Methodological flow of the study.

3.4 Ethical considerations

Broadly, I followed the Economic and Social Research Council's guidance on research ethics[10], using this to supplement the ethics process of my department. Throughout the research, informed consent[11] was obtained from interviewees and efforts to anonymize participants were undertaken to avoid unwanted disclosure.

More specifically, consent was treated as a process, rather than a moment. Initially consent entailed meeting the local community officials, both traditional and governmental, before validating this consent at the provincial and then district level government offices. With the appropriately stamped paperwork, I was then able to begin the process of building relationships within Community A. Through the ethnographic fieldwork I spoke constantly about my purpose and role, outlining the scope of what and would not be used, mindful of reactions, rejections and objections. As the research moved towards interviews and surveys the field research team and I ran a series of small role-plays outlining consent within different local contexts. These were presented at a community meeting to facilitate discussion about research consent. If we thought households seemed unsure during the initial conversations before a household survey, we offered the opportunity to come again on a different day, to arrange different times, or to speak to one of the local shop owners who acted as a key point of contact for clarifying our research objectives. The shop keepers in particular were invaluable as a source of questions from residents and helped us understand the gaps between our intentions, local perceptions and local expectations.

This research deals with livelihoods that form a complex mix of informal and illegal. The two are not necessarily synonymous, as legal pluralism, the application of de-facto governance regimes and contested definitions between producing communities and authorities can blur the distinction (Cavanagh et al. 2015). What is apparent however is that informal and illegal livelihoods can often be precarious due to their complex status in the eyes of the state (Cavanagh et al. 2015; Spiegel 2012).

[10] http://www.esrc.ac.uk/funding/guidance-for-applicants/research-ethics/

[11] This was usually recorded, or witnessed due to local mistrust of contract signing within the primary case study area.

Violent clashes between police and another group of informal producers, gold and tourmaline miners, are common within the primary case study area (Baptista 2016; Lusa 2015). Recent large-scale forestry concessions within the study area could potentially lead to similar conflicts over resource access for charcoal producers. Thus, given the informal/illegal nature of charcoal production, I have therefore taken steps throughout the research to protect the identities of the study areas and participants. Both case study areas and interviewees are anonymised throughout the thesis.

Interviews with local regulatory authorities were conducted after research with charcoal producers. This helped limit concern among local producers that we were working alongside the district agricultural department (DDA). A local charcoal trader and traditional leader were invited to sit in on the interviews so they could report on the content to local producers. No specific data on households, exact areas of research, on licensing prevalence, enforcement avoidance or other sensitive topics were passed on to the DDA.

The research team held regular meetings with local traditional authorities and advertised "question points" at three local shops, where we left summaries of our findings, simply phrased in the local language. We also discussed with the shop owner the details of our research, so they could help field questions after the research team left the study area. Finally, community meetings were held at the beginning and end of the research in order to provide transparency about the content and purpose of the research process.

4 Thesis outline

4.1 Structure of the thesis

Three self-contained empirical chapters now follow. A brief summary of their arguments are outlined below. Each chapter corresponds roughly to a research question: Chapter two explores question one, chapter three question two and chapter four question three. Following the three empirical chapters in the final chapter I synthesise and discuss the findings, as well as providing my general conclusions and reflections.

Chapter two introduces the primary case and unpicks the singular notion of who charcoal

producers are and why they produce. I explicitly highlight the diversity of situations that charcoal is produced in, and argue that this diversity is dealt with poorly by the current licensing regime. This is one of the first in-depth case studies of charcoal production for a small town (see also Smith 2016) and one of very few studies to explore variation amongst people producing charcoal, rather than defining them as a livelihood-based group in contrast to everyone else. The argument develops from asking these questions:

- What is the history and livelihood context of charcoal production in the study area?
- What are the situations in which people make charcoal?
- How do these situations link to the role that charcoal plays within local livelihoods?

Chapter three builds on this nuanced picture of charcoal production. It looks at an aspect of charcoal production common within the case study – the linking of field opening and charcoal making. I jointly theorise how a variety of processes lead to the linking of charcoal and agriculture, to show how this practice emerges, not only from simple on-farm economic decisions, but as a function of local governance and ideas about legitimate livelihoods. In doing so, I provide a novel perspective on the charcoal-deforestation debate, arguing that we cannot continue to separate "drivers of deforestation" when field-opening practices and charcoal production are closely connected.

Thus in chapter two I ask the following:

- How are charcoal production and agriculture linked as practices?
- How has this link formed within the case study?
- What are the implications for our understanding the link between charcoal and forest loss?

The fourth chapter focuses on the formalisation of charcoal markets. Formalisation is a common "solution" for a wide variety of resource management issues, but its impacts are mixed and contested. I use Mozambique as a case study to explore some of these issues for charcoal – one of the largest sources of informal employment in sub-Saharan Africa. I argue that formalisation in Mozambique is predominantly shaped by environmental concerns. This leads to a regulatory system that excludes smaller producers as it

misunderstands the role that charcoal plays within their livelihoods. The argument is built on empirical data from two Mozambican provinces and explores the outcomes of changes in Mozambique's forestry legislation in 2012. The chapter concludes by exploring how approaches to charcoal markets and informal markets could benefit from engaging more directly with informality. The following questions are explored over the course of the chapter:

- What is the nature of charcoal's formalisation in Mozambique?
- What was the impact of the 2012 reforms on formal and informal charcoal production in the two study areas?
- How has this affected small producers' market access?

Chapter two

Charcoal as a diversification strategy

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Summary of contributions: Daniel Jones designed the study, undertook the field work, the data analysis and wrote the manuscript. Casey Ryan contributed to the sampling design, helped with data analysis and contributed to the formulation of the argument. Janet Fisher contributed to the argument structure and helped refine its focus.

1 Introduction

Fuelled by the preferences and demands of increasing urban populations (Arnold et al. 2006; Girard 2002; Maes & Verbist 2012), charcoal production continues to rise in sub-Saharan Africa (Bailis et al. 2005; IEA 2014). Charcoal's clean, even burn makes it popular with urban consumers (Ribot 1993), and it has become the principal energy source in the region's urban areas over the past couple of decades (Sander et al. 2013). In 2012, 36 million tonnes of charcoal with a market value of around $11 billion was produced to fulfil this growing demand (IEA 2014). Charcoal is a key contributor to the livelihoods of millions of people across the region. In Mozambique, for example, the number of people participating in the production, trade and sale of charcoal could be as high as 3 million - 15% of the population (Cuvilas et al. 2010). Roughly three-quarters of people employed within woodfuel markets are based rurally (Openshaw 2010) and up to 50% of revenues are retained in rural areas (IEA 2014).

Yet, despite these headline numbers, views about charcoal markets are still primarily shaped by older worries about woodfuel shortages and (energy) modernisation narratives (Mwampamba, Owen, et al. 2013; Owen et al. 2013; Ribot 1999). This leads to a negative attitude towards charcoal production as a livelihood. The pervasive caricature of a charcoal producer is that of a man, poor in productive assets and land (Mugo & Ong 2006; Ainembabazi et al. 2013; Arnold et al. 2006; Bekele & Girmany 2013), with less access to agricultural markets and no alternative income (Ainembabazi et al. 2013; SEI 2002; Openshaw 2010; Zulu & Richardson 2013; Arnold et al. 2006). In short, charcoal production is seen as a "last-resort type of livelihood activity" (Cavanagh et al. 2015, p. 77), for those "without much alternative" (Bekele and Girmany 2013, p. 19). Thus, making charcoal is framed as a safety net (Arnold et al. 2006), a shift in strategy as agriculture becomes a less reliable income source (Levy & Kaufman 2014) or as income support in households with lower agricultural capacity (Luoga et al. 2000). Using this framing, participation in charcoal (and woodfuel markets more generally) is thought to oscillate inversely with agricultural labour demands and fluctuate with urban job opportunities and crop incomes (Townson 1995; Gandar 1992).

However, a nascent cluster of literature on charcoal is beginning to consider the role of charcoal in rural livelihoods from a different perspective (Arnold et al. 2006; Shively et al. 2010; Mwampamba et al. 2013; Owen et al. 2013, Khundi et al. 2011; Zulu and Richardson 2013; Schure 2014). For these authors, whilst agricultural strategies may be different for charcoal producers, this difference is not necessarily due to varying land availability or agricultural capacity (Khundi et al. 2011). They argue that rather than charcoal production being solely the preserve of the poor, people make charcoal across a wide range of income levels, leading to higher incomes than comparable non-producing households and lower poverty rates amongst producers (Khundi et al. 2011; Ainembabazi et al. 2013). Charcoal is framed as a livelihood diversification strategy rather than simply a "stop-gap", "safety-net" or "livelihood of last resort" (Chileshe 2005; Zulu & Kalipeni 2009; Ainembabazi et al. 2013; Schure 2014).

Knowledge about charcoal market participation is highly contextual (Ros-Tonen & Wiersum 2005; Schure, Levang, et al. 2014). Yet, the majority of work on the role of charcoal in rural livelihoods focuses on a specific context: commodity chains and producers supplying principal cities (Shively et al. 2010; Kambewa et al. 2007; Sander et al. 2013; Brouwer & Magane 1999; SEI 2002; Ribot 1993). This focus is fairly unsurprising; large urban areas consume a lot of charcoal. But the preoccupation with large cities and the role of charcoal production in forest loss around them has two major impacts. Firstly, it leaves knowledge about commodity chains to be extrapolated to cover large areas, undermining academic understanding of woodfuel sustainability by overestimating extraction and ignoring regional variation in modes of production (Gao et al. 2011; Bailis et al. 2015). Secondly, it leads to the impression that large commercial producers, working with hired labour, dominate charcoal commodity chains. This is not the case (Leach & Mearns 1988; Schure, Levang, et al. 2014; Kambewa et al. 2007), but due to the diffuse and intermittent nature of production amongst smaller producers, less is known about the dynamics of their market participation and the role of charcoal in their livelihoods (Kinyanjui 1987; Kambewa et al. 2007).

Alongside the increasing consumption in major cities, the increasing use of charcoal in small and medium sized urban areas is particularly striking (Girard 2002). A large

proportion of Africa's urban growth is projected to be absorbed by settlements with under one million inhabitants (United Nations 2014), and will be accompanied by increasing charcoal consumption in these urban areas (Ibid.). Despite this trend, few data exist on charcoal producing areas supplying such towns and cities (Smith et al. 2015). To counter this, we provide here an in-depth look at charcoal producers supplying a small town of 30,000 people in central Mozambique. The majority of these producers only make charcoal sporadically, on an ad hoc basis. Using a case study approach, we document the diversity of charcoal production through a mixture of qualitative and quantitative methods and explore the roles that charcoal takes within producers' livelihoods. The following questions provide a guiding framework for the case that follows:

1) What is the history and livelihood context of charcoal production in the study area?
2) In which situations do people produce charcoal, and why?
3) How do these situations link to the role that charcoal plays within rural livelihoods?

A common approach in studies of charcoal producers is to infer "why" charcoal is produced from quantitative household surveys. This approach is powerful when describing who producers are, but weaker for understanding the "why" of charcoal production. Such an approach tends towards inferring post-hoc, that because a household is characterised by certain features (i.e. less agricultural capacity), charcoal must take a certain role within their livelihood strategies. To avoid this, we focus directly on the situations in which charcoal is produced. These production situations are understood through qualitative analysis and linked to information about prevalence through a household survey.

The chapter starts with an overview of the case study area, followed by a brief methodology. The results follow the questions outlined above, before the discussion hones in on the role charcoal plays for smallholders, tying this back into overarching debates on the place of woodfuels within rural livelihoods. Particular focus is placed on what this case study of a small town might say about such debates.

2 Study area and communities

Community A lies in Manica Province in central Mozambique. It is around 50 kilometres away from a small market town (Town A) of around 30,000 people (República do Moçambique 2005). Community A covers most of a single administrative post which is home to around 16,000 people (Ibid.) and encompasses four chieftaincies.

Like much of the district, the study communities suffered in both the Zimbabwean Liberation Struggle and the Mozambican Civil War. The vast majority of the population fled over the border in '80s, returning from the early '90s. This influx has been fairly consistent, bar pulses of migration from Zimbabwe as economic strife across the border took hold in the later '00s.

The majority of residents in the study area consider themselves farmers, almost all of whom rely on rain-fed agriculture (see methods section and table 1 for the sources of the information in this section). The warm, wet season spans October/November to March/April, and as a result planting coincides with this pattern; the rest of the year is comparatively cool and dry. Households generally cultivate 1-2 hectares, with their crops and cropping practices diverse. Everyone however, grows some variety of maize. This is often supplemented with a "garden" - a bamboo-fenced, area of naturally wetter land set aside for horticulture. There are varying mixes of commercial focus, ranging from some farmers who regularly sell or plant a cash-crop (typically soya) whilst others sell and trade depending on their needs and yields. There are limited opportunities for wage employment[1].

Households tend to dwell in scattered *mushas*, or homesteads. Most *mushas* are closely tied to their fields, or *machambas*. Local forms of tenure provisioned for under Mozambican law dominate, with parcels of land distributed via the chief and in negotiation with neighbours. These forms of tenure, as elsewhere in the province, are complex, multi-faceted and overlapping (Walker 2012) and combine to create a patchwork landscape. This patchwork landscape is characteristic of areas of Mozambique

[1] Farm labour is still predominantly based on reciprocal exchange, though a small subset of farmers hire labour for clearing.

with high woodland/forest cover and comparatively high population densities (Sunderlin et al. 2008).

Most families have woodland at the edges of their *machambas* and do not have to travel far for firewood[2], fruit and most construction materials. A variety of norms regarding the use of forest resources overlap in the woodland areas. The woodlands are a common pool resource for prevalent local fruits, mushrooms and insects, though private usage rights apply to the trees themselves as well as certain foraged foods and materials. The local agricultural department classifies the woodland as "*Uapaca-Parinari*" named after two dominant local species *Uapaca kirkiana* and *Parinari curatellifolia*, though much of flora and fauna is typical of the wider miombo eco-region (Campbell 1996). This makes the dynamics of the woodland comparable with other southern African woodland systems.

3 Methodology

3.1 General approach

This chapter draws on unstructured and semi-structured interviews conducted across the charcoal commodity chain; group interviews with key stakeholders, and; a household survey within Community A. These methods are reinforced and contextualised by ethnographic fieldwork, both within Community A and in other areas providing charcoal for Town A. For a table documenting the information provided by each method, please see Table 1.

3.2 Methods

After an initial period of ethnographic fieldwork in charcoal supplying areas around Town A, in-depth semi-structured interviews were undertaken with charcoal (n= 22) and non-charcoal producing households (*n*=42). These initial interviews provided a backdrop for characterising Town A's charcoal market and covered livelihoods, agricultural/charcoal producing practices and perceptions about resource access.

Data from interviews along the charcoal commodity chain of Town A informed the

[2] Despite the prevalence of charcoal making in the area, use in Community A is rare (5% of the sample in the last 30 days).

selection of Community A. This commodity chain analysis included semi-structured and unstructured interviews with producers, community members, local authorities, transporters and charcoal sellers. It also outlined the commodity chain and determined the differing areas that supplied charcoal to, the nearest city Chimoio and to Town A.

The local department of agriculture kindly allowed access to its historical licensing receipts for charcoal. These receipts cover the period from November 2011 to June 2014. Quantity, provenance and date information were recorded for all available license receipts (n=495). A random sub-sample of 100 was digitised in their entirety including the gender of licensee and cost of the licence. Further statistical information on charcoal licencing and production at the provincial level was provided by the provincial forestry department.

3.3 Questionnaire survey

A questionnaire survey of 235 households in Community A was conducted in July 2014. Due to the dispersed nature of the community, a traditional "village-based" sampling strategy was not possible. Instead, three study areas were defined by drawing 'catchments' around three key trading posts. Catchments were defined by the distances that households would likely travel to for basic goods (soap and salt). Once defined, these catchments were subsequently refined in conjunction with a focus group of local leaders to create the final three study areas. The three study areas correspond, in part, to local chieftaincies and all are involved in supplying charcoal exclusively to Town A. During the interview process, households were given the opportunity to self-identify to a geographic area and define which trading post they travelled to. This enabled us to cross-verify our original sampling design. The stratification of the sample through the choice of three catchments was initially intended to enable comparison Interviews had suggested some differences in agricultural practices and livelihoods, however these turned out to minimal and thus the three catchments are treated as one unit, representative of the sub-district (sede) that the study was carried out within.

Using high-resolution satellite imagery, all households were geolocated. 30% from each study area were selected by simple random sampling, creating a sample of 235 households in total. Out of these, 201 households were interviewed. Three refused, in part related to

worries regarding the subject matter of the questionnaire and 31 households were either mistakenly tagged buildings or abandoned houses.

The household survey was carried out during July 2014. Interviews were predominantly conducted in chiManyika and Portuguese. The questionnaire sought basic information on family structure, livelihoods, fields and agricultural strategies. More detailed questions concentrated on the opening of new agricultural fields and charcoal production, including ranking exercises about decision making when clearing land. Respondents were asked questions on the situations in which the household made charcoal, derived from categories developed in focus groups within Community A. The focus groups developed three, overlapping, non-exclusive situations in which charcoal was produced: "as part of the process of opening a new field", "as a key livelihood" and "when the household needs cash". These situations were later ranked by interviewees within the household questionnaire, in order to best describe their own charcoal production situation. These production situations are used to summarise the quantitative data within the results section. Following the conclusion of the survey a subset of ten charcoal making households were re-visited for in-depth qualitative interviews. This enabled better triangulation between the qualitative and quantitative data.

Quantitative data was analysed using SPSS v 22.1 (IBM Corporation, New York). Chi-square tests were used to test for associations amongst categorical variables (e.g. between production situations and gender). T-tests were used for understanding differences between male and female licensees. Standard errors of proportions and the standard error of means are indicated via the ± symbol.

Method	Data used in this chapter	Conducted
Ethnography and initial semi-structured interviews	The charcoal production process, land-use patterns and history, historical context, relation between key groups, gendered attitudes towards crops, attitudes towards charcoal as a livelihood	August-December 2013
Commodity chain analysis	Sources of charcoal for Town A, relationship between key stakeholders, governance and access to the charcoal market	May-June 2014, November 2013
Focus groups	Attitudes towards charcoal, types of production situation, gender and charcoal production, seasonal patterns of income	June 2014

Survey	Prevalence information relating to charcoal and charcoal practices, household characteristics	July 2014
Follow up interviews	Gendered aspects of charcoal production, attitudes towards charcoal as a livelihood, charcoal production practices	July 2014
Key stakeholder interviews	Governance and regulation of the charcoal market, historical context of market development, sources and forms of production, licencing data and production statistics	July-August 2014

Table 1 – Data types and range categorised by source method.

4 Results

4.1 Local charcoal production: The context

Charcoal making is widespread within Community A; 44% ±7% of households made charcoal within the past 12 months. Despite the considerable numbers producing charcoal it is an activity that has grown to its current state only over the last 5 years (CA-1; G-11).

Between 2012 and 2014, the administrative post which contains Community A provided around a quarter of the licensed volume of charcoal arriving in Town A. Charcoal is formally regulated under the Mozambican forest law (GOM Forest Law, 1999; Decree No. 12/2002 and subsequent modifications e.g., Decree no. 30/2012), but most producers in this study area operate without licences. Changes in the requirements for an ordinary licence in the 2012 Forest Law (Government of Mozambique 2012) stipulated increased land-use planning and an increase in tax from 10 MZN to 60 MZN per stere[3] of charcoal ($0.22-$1.32). This led to the complete cessation of licenced charcoal entering Town A (G-10; G-11). The broader impact of this change is underscored by an 80% reduction in the number of sacks licenced in Manica province the following year. Interviewees at the district department of agriculture and with producers described the situation as untenable (G-10; G-12), and within months local agricultural departments reverted back to the previous cost structure and removed the forest management requirements outlined in the licensing law (G-10; G-12). Under this de-facto licencing regime, wholesalers in Town A purchase licences for transporting charcoal (G-12), removing the tax burden on producers.

Concern amongst the local traditional authorities about forest loss and a movement away from "traditional" patterns of livelihoods has led to the regulation of charcoal by the local chiefs (CA-1; CA-3; CA-4). Within one chieftaincy, production is allowed only as part of opening up of new fields (CA-2); in others, total bans on production were only lifted in 2013 (CA-3).

[3] Widely interpreted as one sack of charcoal by forest department officials.

4.1.1 *The charcoal commodity chain and production process*

Charcoal is predominantly made on each household's own smallholding. However, 20% of producers made charcoal on borrowed land, mostly belonging to neighbours. Charcoal producers see the work as hard and risky to their health. "The more you burn the older you grow", according to one producer (CA-5). Unsurprisingly, given the physical nature of the work, the labour burden is shared; a third (n=29) of producing households enlist help from family, friends or neighbours from outside the household during the charcoal making process. According to group interviews and the survey data, reciprocal labour exchanges amongst friends and family when clearing land or stacking kilns are common, as are profit sharing agreements.

Areas for placing a kiln are selected by weighing up soil fertility (if clearing for a new field), abundance and size of preferred charcoal making species and proximity to existing fields (see also chapter three). After an area has been chosen, trees are either selectively harvested around a strategically placed kiln or entire areas are clear felled. A common approach is to combine these methods, clear felling a smaller area and supplementing the kiln with higher diameter charcoal making species from around the fringes. This is often done as part of the process of extending an existing field.

Trees are felled by axe. Mussasa (*Brachystegia spiciformis*) dominates the charcoal mix and is used by 81% of producers. Mufuti (*Brachystegia boehmii*) is also used (by 21% of producers). If clear felling, a wider species mix is often used, including some species with a lower wood density avoided by better informed producers. Group interviews suggested the use of edible fruit trees such as Muzanje (*Uapaca kirkiana*) is generally frowned upon.

Once felled, trunks are tightly stacked between two sets of supporting poles, sometimes including a tree that has been left standing. The kilns can reach 2 meters high and up to 20 meters in length, though group interviews suggested an average of around 5 meters long. After drying for around 2 weeks, trunks can be covered with small green branches, grass or occasionally horticultural waste. The kiln is then covered in earth, with a hole left in the top to enable ignition. As the smoke changes colour from the kiln, this is then sealed. After what is described by producers as "a good burn", a 5 m kiln can yield around 25 sacks of approximately 40kg each. This is significantly reduced if the kiln coating

develops large breaks. Too quick carbonisation will lead to fine material, not of use for selling. As a result, lit kilns need a lot of attention and most are positioned close to the homestead.

After a few days to a week, depending on the kiln size, the charcoal is then dug out from one end of the kiln. Ideally the finished product should be heavy enough to indicate a good source wood, but not so heavy as to indicate a large amount of moisture. A sheen is also indicative of a good quality. The lumps of charcoal are then stuffed into sacks extended with a combination of bark string and sticks. Sacks produced are bought by traders from locally arranged pick up points or are taken on public transport in small quantities. Traders pay 60-80 MZN ($1.37-$1.83) for each sack in Community A, which is 30-40% of the final retail price in the town (200 MZN)[4]. Alternatively, taking charcoal on public transport costs 30 MZN/sack ($0.69). This relies on a loophole in the Mozambican law, which allows small quantities of charcoal (3-5 sacks) to be produced (and transported) without license for "personal consumption" (GA-12; CC-1). Thus charcoal travelling in this manner is unlikely to be taxed and the produce can be sold on for the full retail price in Town A (GA-12; CC-1; CA-5).

4.2 Charcoal production situations

Approximately half of producers (48 ± 10 %) make charcoal as "part of the preparation of a new field", 32 ± 9 % as a "key livelihood" and 21 ± 8 % "when the household needs cash". Across the production situations, households are similar in terms of size, age and have similar proportions of principally female decision makers (although non-producing households are slightly more likely to have principally female decision makers) (Table 2). There were differences in some aspects of household agricultural practices (e.g. proportion planting purchased maize varieties, which focus groups suggested as a prosperity indicator) and ownership of high-value cash assets (represented here by percentage ownership of solar panels) (Table 2). Women's involvement in charcoal production varies across the different production situations. The production situations also show

[4] This is in line with findings from elsewhere in the Beira corridor (Sitoe et al. 2007) but in contrast to areas supplying Maputo, where retail prices are much higher.

differences in the frequency and quantity of production (Table 2).

		N=42		N=27		N=19		N=113	
		PRODUCTION SITUATION						NOT PRODUCING	
		Field		Livelihood		Cash			
		Mean	SE	Mean	SE	Mean	SE	Mean	SE
hh structure	Household size (#members)	7.5	0.66	6.7	0.55	9.4	0.85	6.5	0.38
	Age of household (#years since formation) *	15.5	2.3	14.6	2.80	15.6	2.00	14.4	1.42
	Principally female decision makers (% hh)	12.2	9.9	11.1	11.9	10.5	13.8	17.3	7.0
	hhs using purchased maize seeds (%)	26.2	13.3	11.1	11.9	10.5	13.8	30.3	8.50
Wealth indicators	Livestock Units owned (TLU)	3.0	1	3.7	0.93	2.7	0.75	3.3	0.63
	Food poor (% hh) **	9.8	9.0	14.8	13.39	10.5	13.8	17.4	7.0
	Ownership of solar panels (%)	26.8	13.4	38.3	18.3	52.7	22.5	31.3	8.56
	Principally female producers (% hh)	11.9	9.8	14.8	13.39	57.9	22.2		
Charcoal production	Number of months produced	2.2	0.3	4.96	0.93	1.72	0.27		
	Sacks produced (#) ***	42.7	6.3	92.9	22.30	32.7	7.21		
	Most common second ranked production situation	Livelihood		Cash		Livelihood			

* Years since formation defined by time since the primary economic decision maker(s) left their parents' home.

** Defined as households who reported that maize yields and incoming expenses had not been sufficient to meet the household's food requirements over the past year.

*** During the last felling event

Table 2 - Household characteristics divided by primary situation in which charcoal is produced: "as part of the process of opening a new field" (field), "as a livelihood" (livelihood) and "when the household needs cash" (cash). Non-producing households are included as a reference. Chosen wealth indictors are based on focus group discussions and interviews.

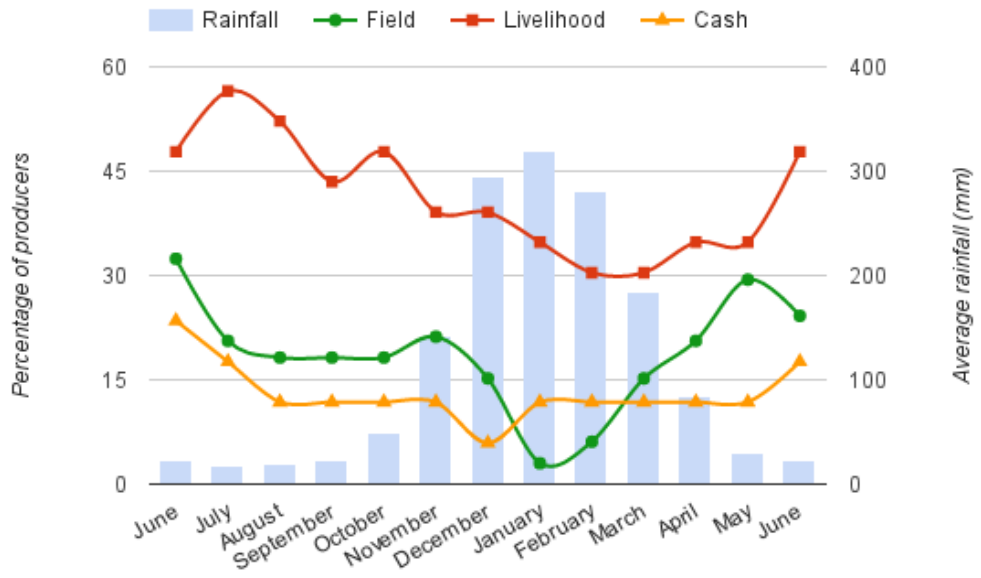

Figure 3 - Percentage of producers producing in a given month categorised by primary production situation: "as part of the process of opening a new field" (field), "as a livelihood" (livelihood) and "when the household needs cash" (cash). The graph covers June 2013 to June 2014. Maize harvest is in April/May. Fields are usually opened between late April-July.

Who participates fluctuates across the year (Figure 3). The percentage of the sample households making charcoal in a given month varied from 13% and 6% across the study year. Lower levels of production coincide with the rainy season and the peaks with field clearing and the agricultural off-season. In 23 ± 8% of charcoal making households the production was done principally by women and in around 31 ± 9% of households' production was principally done by men. Within the rest of the households (46 ± 10%), participation was a joint activity, with men and women participating equally. Notably, women were the main producers in households that produced within the "cash" production situation (Table 2).

The average number of months in which charcoal was produced was 3 (± 3). Within the sample 49 ± 10% of charcoal producers made charcoal in only one month over the past 12 months[5]. This production is fairly evenly spread across the year. 60 ± 10% of households had a member produce in two consecutive months, a figure which rises to 73 ± 9% for three consecutive months. This suggests that, for most households, charcoal

[5] Referring to the period June 2013 to June 2014

production is a "one off" occurrence during the year. Drawing lines between regular production, ad-hoc production and the importance of charcoal to the household is difficult. One regular producer framed this distinction as "Our business is agriculture; we burn [make] charcoal for pleasure" (CA-6). This statement hints at the complex attitudes towards charcoal production as a livelihood – discussed further in chapter three. Succinctly, local attitudes towards regular or full-time charcoal production are predominantly negative, whilst the occasional production of charcoal as part of agricultural practice is seen as being more financially and ecologically stable.

4.2.1 *Producing for a living*

Only five out of the 89 charcoal producers within the sample make charcoal all year round, though 27 ± 9% produced charcoal in more than three months. Interviewees describe involvement in charcoal making as fluctuating with opportunities for cash income (CA-5; CA-7; CA-8; CA-9). A tobacco-outgrowing scheme collapsed in 2012, removing the only major opportunity for cash income, other than selling surplus maize (CA-1; CA-10). This gap in cash cropping opportunities was partially filled by the uptake of soya, though this crop has yet to spread widely in the study area. Other households were left looking for alternative sources of cash income, as selling a maize surplus is a difficult and unreliable form of making money (Hanlon & Smart 2013).

In 2014, the survey year, a forestry company was clearing land and so provided a source of wage labour[6]. Both charcoal producing and non-producing interviewees emphasised that there were fewer "regular" producers in 2014 due to this incoming wage labour and emerging cash cropping opportunities (CA-2; CA-5 CA-11; CA-12; CA-13). The survey, however, displays little flux in the number of producing households – with continuous growth over the past five years. Furthermore, the volume of licenced charcoal flowing to Town A has remained fairly constant over our licencing sample period.

4.2.2 *Gaining financial autonomy*

The majority (58 ± 22%) of production within the 'need cash' categorisation is

[6] Interestingly, the forestry company is letting locals use the cleared trees to produce charcoal, charging 30 MZN for each bag that leaves the kiln (G-25).

undertaken by women (x^2 (4, n=89) = 17.61 p=.001, Cramer's v = .316 (moderate association)). Female producers tend to produce charcoal irregularly, pooling labour from outside the household, mainly the labour of other women. The survey data shows 58 ± 10% of participating women used labour from outside the household compared to 33 ± 9% in households where production was led by the men or a joint activity.

Three quarters of female producers are based in households where men make the economic decisions. As a comparatively new income source there appear to be few gendered rules surrounding charcoal production. Garden horticulture and ground nuts are sold locally by women, who pass a portion of proceeds back to their husbands (CA-10; CA-14; CA-15; CA-18). Charcoal, on the other hand, appears to allow women to produce charcoal outside of their husband's purview, providing an important source of cash (CA-7; CA-8; CA-16). Production takes on a variety of forms. Female producers commonly work together, creating groups of producers across households. For example, one group of women produced charcoal together in order to purchase capulanas[7] to sell locally, whilst another made charcoal in order to send money to family members in Zimbabwe. Women's involvement in the charcoal market is further underscored by the fact that almost 50% of the licences issued in Town A were issued to women. The number of sacks each licence was issued for is on average lower (21 ± 16 sacks) than that of men (37 ± 29 sacks).

4.2.3 *A quick source of cash*

Around 36% of households purchased a specific good or paid an expense using charcoal finance. These ranged from agricultural inputs and solar panels to cash transfers to a bride's family (lobolo). Those making charcoal to cover a specific expense produced more bags, the last time they produced, than other groups (93 sacks vs 41 sacks, two tailed t-test t = 3.09, p = 0.01). One household made 125 sacks in order to fund the purchase of a house in a nearby town.

As observed elsewhere, charcoal is also used as a coping strategy for shocks that interrupt the household's income stream or reduce its asset base (Schure, Levang, et al. 2014). One

[7] A Mozambican sarong/multi-functional piece of fabric

family produced charcoal as a one-off to purchase belongings after fire destroyed their home (CA-17). Those convicted of starting the fire helped the household fell trees for the kiln (CA-2; CA-17). A different form of shock response is demonstrated by two women who lost their husbands and made charcoal at a small scale to provide cash income, its returns more reliable than selling a maize surplus (CA-16; CA-19). The proportion of food-poor households making charcoal during the hungry season was higher than the non food-poor and this could be seen as a response to this predictable shock – a strategy also seen in other non-charcoal contexts (Dercon & Krishnan 2000).

Charcoal production following the rainy season also serves to generate working capital and facilitate field clearance for the coming agricultural season (Chapter three). If households are opening new fields, the extra labour cost of charcoal production is low. Interviewees framed this as making charcoal production logical and efficient (see chapter three). However, the full extent to which charcoal finance feeds back into other livelihood strategies is unclear. 20% of households bought agricultural inputs or equipment with charcoal finance, but without extensive income data (preferably from panel-based studies), understanding the ripple effects of this cash income source is difficult.

5 Discussion

5.1 The role of charcoal in rural livelihoods

Currently, charcoal production in the study area is dominated by occasional producers, linked to the opening of new fields and fulfilling a need for cash. Because of its flexibility as a cash income source, charcoal is produced by a wide range of people, for a variety of reasons. The scale and timing of production is closely linked to the situation and reasons for producing. This contrasts with the existing literature which suggests that those with predominantly agricultural livelihood strategies who also produce charcoal don't produce in large quantities (Arnold et al. 2006; Kambewa et al. 2007). The scale of charcoal production cannot be divorced from the motivation behind its production; whether that be for subsistence income (Butz 2013), starting a new business (this study) or wanting a bicycle in order to keep up appearances (Serra 2001).

The local narrative echoes the literature, explicitly tying charcoal production to a lack of

alternative opportunities. Interviews with producers and non-producers emphasised a reduction in charcoal production in 2014, linked to alternate cash generating opportunities. However, there is a disconnect between this qualitative data describing fluctuating production and the quantitative survey and licensing data, which both demonstrate a continuous growth in the number of producers. This disconnect might reflect a reduction in the number of producers focussing their livelihoods on charcoal production - arguably the most visible form of production due to its regularity and volume. Such a reduction in regular producers could be linked to the actual/perceived availability of wage labour. It could however be linked to the local politics of production, which makes sporadic charcoal production as part of field opening more locally acceptable (see also chapter three).

It is also difficult to frame a drop in cash-cropping opportunities (e.g. the collapse of the tobacco out-growing scheme in 2012) as the sole force behind an upsurge in charcoal production. Firstly, focus groups stated the number of charcoal producers is much greater than the historical number of tobacco producers, and secondly charcoal's importance and function within household livelihood strategies is more variable than tobacco growing. Such nuances suggest a framing of charcoal that emphasises (negatively) its role as a response to deprivation obscures important parts of the picture.

In contrast to previous studies which have reported little female involvement (Seidel 2008; SEI 2002; Malimbwi et al. 2010), in this area women are widely involved in making charcoal. Likewise, the roles that women play in charcoal production differ in comparison to the literature. In the only study (to the authors' knowledge) using a gendered focus on charcoal, Butz (2013) documents "economically and socially marginalised women" (Ibid, p. 143) producing small quantities of pit-charcoal to provide subsistence income. Here we wish to emphasise the positive use of charcoal by female producers, who use it to gain a degree of financial autonomy from their husbands. This could enable them to strengthen their position within the "conjugal contract" (Whitehead 1981; see also Pfeiffer et al. 2001) as well as address personal financial needs or needs that fall outside the household. Income from agriculture is usually controlled by the main economic decision maker within the household, meaning charcoal could lead to more

equal forms of cash earning. Similar situations occur in charcoal producing areas providing Zomba, Malawi (Smith 2016). In a similar vein, focus groups and interviews from this study show some sons get involved with charcoal production to generate cash to start up a life outside of their parents' home and to gain financial autonomy from their parents (CA-5; CA-21; CA-22).

Whilst highlighting the role of charcoal as a proactive form of income generation, the results do also show charcoal production can be used reactively as a response to shocks. Shocks take many forms (Baylies 2002) and households in the area utilise charcoal production to respond to them in different ways, depending on the shock type. The flexibility of charcoal as a cash income source can lead to households producing in bulk to respond to one-off shock events, or turning to charcoal as a longer-term response to deprivation.

Given the wide variation in production situations, describing charcoal production as a last resort would obscure the livelihoods of many producers within this study area. Charcoal makers cover a spectrum of different people, with varying constellations of livelihoods, assets and opportunities. For those producing charcoal in Community A income from charcoal is mainly supplementary, seasonal and occasional. Sometimes it is tied into field clearance, sometimes the agricultural off-season. These varying forms of production have also been observed in the commodity chains supplying principal cities (Townson 1995; Levy & Kaufman 2014; Schure, Levang, et al. 2014), but are rarely emphasised. Within this study area, the flexibility charcoal provides as a cash income source leads to a high level of diversity in production situations. Given this diversity of production situations and close links to existing agricultural practice, charcoal production is primarily being used as a diversification strategy.

5.2 Local regulations engender flexibility

The local regulatory framework, is a key enabling factor within the study area, allowing easy entry into the production sector. Flexible production would become untenable if Mozambique's current licensing regime were enforced (see also chapter four), and it is this form of production which is perhaps the most important for vulnerable households.

The corollary, is that under this informal system, the rules governing resource management are ill-defined. Local governance via the traditional authorities is playing a role in this regard, as local chiefs are asking charcoal producers to show their licenses and stipulating conditions for production (CA-1; CA-2; CA-3; see also chapter three). But as the vast majority of charcoal is produced on each household's smallholding (to which they have locally derived usufruct rights) rather than on common land, the current de jure licensing regime in Mozambique is untenable for individual households (see chapter four). The adoption of a de-facto licensing regime in this study area, exemplifies this. The requirements in law for a license involve substantial costs and unrealistic forest management criteria (see chapter four for an in-depth discussion). By way of example: as written in the law, the cost of a license (69 MZN per sack) represents 35% of the retail price in Town A and 115% of the price paid to producers in Community A. The substitution of a formal licensing arrangement with a de-facto taxing of charcoal transport has been observed elsewhere in Africa (Shively et al. 2010; Malimbwi et al. 2010). However this is argued to stem from a lack of capacity amongst local agricultural departments (Malimbwi et al. 2010), rather than an unsuitable pricing structure and unrealistic license requirements.

There is less emphasis on flexible, idiosyncratic or occasional charcoal making in the literature, due to the focus on full-time or regular producers supplying major cities and their environmental impact. It is important that the experiences from commodity chains around large cities do not obscure the wide diversity seen in the periphery. This leads us to a key question: how common is occasional charcoal production within the commodity chains of major cities? The indications are that the majority of producers operate on an occasional basis, producing a substantial proportion of the overall charcoal supply (Schure, Levang, et al. 2014; Kambewa et al. 2007). Developing our understanding of this is important, as currently policy and development interventions into charcoal markets across sub-Saharan Africa are premised on formalising community based natural resource management. Given the evidence that such processes can have mixed outcomes in terms of resource access (Ribot 1998; Schure et al. 2013; Zulu & Richardson 2013) care needs to be taken that the formalisation and professionalisation of charcoal production does not

restrict access to those using charcoal as a flexible income source (see also chapter four). Ultimately it is this flexibility that makes charcoal such an important livelihood diversification strategy for rural smallholders.

6 Conclusions

Across the study area, a wide range of households and individuals produce charcoal to increase their incomes. They do so in different situations, leading to charcoal taking a varying role within their livelihood strategies. This contrasts with much of the existing literature that characterises charcoal as a livelihood of last resort. The flexible role of charcoal within producers' livelihoods is enabled by the current de-facto licencing scheme, which sits at odds with the current Mozambican law. Changes to this scheme should be careful not to restrict access to the flexible income that charcoal can provide, as it is one of the few cash income sources that can be engaged in on a flexible basis.

In contrast to existing work conducted on charcoal production supplying major urban areas, this study has focussed on occasional charcoal producers supplying a small town and the varied role of production in their livelihoods. Future studies should look towards both studying the commodity chains of small and medium sized urban areas (see also (Smith et al. 2015)) and better documenting the role of diverse types of charcoal production. These processes are not captured by a pervasive focus on the environmental impact of specialised and formalised forms of charcoal production.

Chapter three

Beyond fuel or field: Linking charcoal production with agricultural practices

1 Introduction

The harvesting of wood for fuel across sub-Saharan Africa has continually been cited as a major driver of deforestation and forest degradation (Fisher et al. 2011). This assertion has been strongly challenged on a variety of grounds (Ribot 1999; Leach & Mearns 1988; Chidumayo & Gumbo 2013) and although misconceptions still continue to shape the debate (Mwampamba, Ghilardi, et al. 2013), a strong counter-narrative suggests that the impact of woodfuels on forest loss has been significantly overstated (Ribot 1999; Bailis et al. 2015).

A common theme within this counter-narrative is that much of the wood that fuels Africa's cooking stoves is actually the by-product of deforestation driven by other activities (Leach & Mearns 1988; SEI 2002; Ribot 1998; Arnold & Persson 2003; Bailis et al. 2015; Dewees 1987). Deforestation as a result of demand for agricultural land (Leach & Mearns 1988; Ribot 1999; Arnold et al. 2006) as well as clearance for commercial forestry (Bailis et al. 2005; Portucel 2014) produces significant volumes of wood. The extent to which this wood is used as woodfuel is uncertain; though the indications are that it comprises a major proportion of the total woodfuel supply. In the Democratic Republic of Congo, for example, around two thirds of Kinshasa's charcoal is provided by agricultural clearance (Schure, Levang, et al. 2014). The link between woodfuel and agricultural clearance is a particularly important one considering that agriculture is widely framed as the most important direct driver of deforestation in sub-Saharan Africa, alongside commercial woodfuel production and timber extraction (DeFries et al. 2010; Hosonuma et al. 2012).

The relationship between fuel and field is framed in different ways within the literature. On the one hand agricultural clearance generates woodfuel (Hofstad et al. 2009; Cline-Cole et al. 1990; Hiemstra-van der Horst & Hovorka 2009; Hansfort & Mertz 2011) and on the other woodfuel production creates land for agriculture (Chidumayo & Gumbo 2013; Ahrends et al. 2010). This variation in sequence goes beyond semantics. Whether an axe is swung to create space for a field or to fill a kiln has important implications for what we say is a direct driver of forest loss. It has theoretical implications

for how we think about deforestation and degradation, within academia and beyond. And it has practical implications for our current attempts to quantify and mitigate direct drivers of forest loss, an important part of the REDD+ process (Salvini et al. 2014; Ryan et al. 2014; Carodenuto et al. 2015).

This chapter explores the link between agriculture and woodfuel production by building on the primary case study developed in chapter two. Its central argument is that by framing charcoal and agriculture as separate drivers of deforestation, we miss the important ways that they interact. In order to make this argument I place smallholder livelihoods at the centre of the analysis, rather than drivers of forest loss. The chapter is organised into four sections. Firstly, the chapter reviews how woodfuels and agriculture are conceptualised as separate drivers of deforestation. Secondly, I return to the case study, to provide an example of how charcoal and agriculture can be intimately linked. Thirdly, I explore why this link arises within the case study area. Finally, in the fourth section I discuss the implications of the case study findings for current interventions into charcoal production and the underpinning theory on drivers of deforestation and degradation.

2 Woodfuel and agriculture as separate drivers of deforestation

A common analytical approach to deforestation and forest degradation, widely adopted by African policy makers and NGOs (Hosonuma et al. 2012), is to distinguish between activities that directly impact forests and the processes which underpin them (Kaimowitz & Angelsen 1998; Geist & Lambin 2002; Turner II et al. 1994). In this "drivers framework" (Figure 4) underlying drivers (which indirectly affect the forest) underpin proximate causes (actions directly affecting the forest). Woodfuels and agriculture are both considered proximate causes (Geist & Lambin 2002; Ryan et al. 2014), and despite widely co-occurring in sub-Saharan Africa, they are conceptualised as distinct drivers of forest loss (Geist & Lambin 2002; Angelsen & Kaimowitz 1999; Hosonuma et al. 2012).

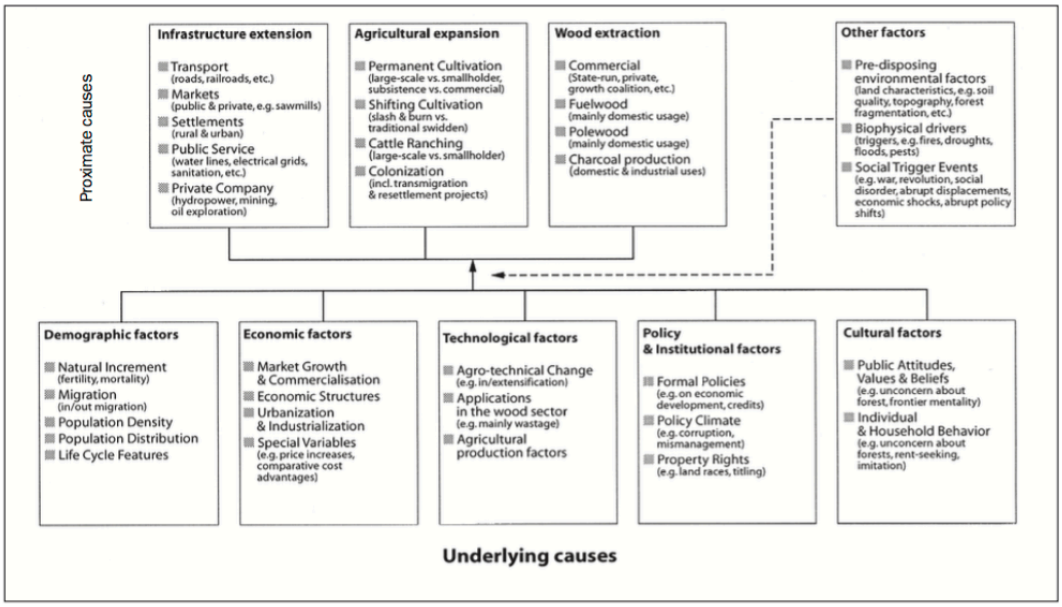

Figure 4 - The proximate and underlying causes of forest loss. From (Geist & Lambin 2002).

Under such a framework, agricultural expansion is considered to be main cause of deforestation in sub-Saharan Africa (DeFries et al. 2010; Hosonuma et al. 2012; Fisher 2010), whereas woodfuel is framed as the main driver of degradation (Hosonuma et al. 2012). Academically, deforestation is used to refer to the long term, complete loss of forest cover (Sasaki & Putz 2009), whereas degradation is the (temporary) removal of all or part of forest biomass (Penman et al. 2003; Sasaki & Putz 2009). Ecologically speaking, woodfuel harvesting rarely causes deforestation or permanent degradation, particularly in dry African woodlands characterised by a re-sprouting ecology (Chidumayo 1993; Syampungani et al. 2015; Cline-Cole 1998; Kalaba et al. 2013). This matters — for example Ribot (1999) remarks at being shocked upon returning to a Senegalese study site heavily harvested for charcoal, only to find it regrown, changing his perception of woodfuel harvesting. Degradation looks a lot like deforestation over short timescales and small areas. Yet despite these shifting ideas, woodfuels are still frequently cited as being an important driver of deforestation (Marzoli 2007; Pereira et al. 2001; Sitoe, Salomão & Wertz-kanounnikoff 2012a), due to a lax application of definitions (Sasaki & Putz 2009; Mertz et al. 2012).

Such observations are particularly pertinent where land-use activities follow in sequence as, without subsequent conversion to agriculture, woodfuel production will lead to forest

degradation rather than deforestation[1]. Where agricultural expansion is framed as a source of woodfuel[2], the implication is that agriculture is the proximate cause of deforestation. Where agriculture is framed as following woodfuel production, woodfuel is framed as the key driver of forest loss (Ahrends et al. 2010; Hofstad 1997). Studies documenting this sequential relationship between agriculture and woodfuel production are usually based on the observation that the one activity follows the other (Mutimba & Barasa 2005; Hofstad 1997; Chidumayo et al. 2001; Ahrends et al. 2010). In many cases the separation of processes is underscored by the language used: Woodfuel produced following agricultural clearance is referred to as a "by-product" – something produced (unintentionally) in addition to the principal product. These observations hint at broader problems with the drivers approach where research primarily concentrates on documenting land-use drivers and relating them statistically, with little emphasis on the actual mechanism of action that links them.

For example, the impact of charcoal production on forests is predominantly deduced from demand and translated to an equivalent forested area to give an estimated impact (Mwampamba 2007; Iiyama et al. 2014). This approach says little about the relationship of woodfuel production to other proximate causes – a key task in attributing forest loss to a particular activity. This leads to a lack of understanding about how the drivers interact, as they are kept as separate analytical objects. Put differently, how do we separate woodfuel production from an underlying demand for agricultural land? Conversely, does woodfuel facilitate agricultural colonisation?

Our understanding of these questions is constrained by a lack of empirical studies documenting agricultural clearance being used to produce woodfuel (Ribot 1999). The practice is frequently noted incidentally (Dewees 1987; Openshaw 1978; Openshaw 2011; Schure, Levang, et al. 2014; Chidumayo & Gumbo 2013; Arnold et al. 2006), although there is little focus on the dynamics of this form of production and its implications. An overall emphasis on large urban areas (see also chapter two) and the

[1] Only if the harvest rate exceeds the regrowth rate

[2] As well as being a precursor to agricultural expansion charcoal production can also follow other drivers such as timber extraction (Ahrends et al. 2010)

environmental impact of charcoal production around them has led to a pervasive focus on large-scale commercial production of charcoal by specialised and professional producers (Chapter one). This is not indicative of the overall picture of charcoal production. There are large numbers of smaller and occasional producers, found in many African countries (Mutimba & Barasa 2005; Sander et al. 2013; Kambewa et al. 2007; Gumbo et al. 2013; Schure et al. 2013).

The volume of woodfuel produced by smallholders and small producers is thought to be a substantial proportion of the total commercial supply (Kambewa et al. 2007 - 42% Malawi; Schure, Levang, et al. 2014 - 70% Kinhasa, DRC). The majority of small charcoal producers are also "small"-farmers (Kambewa et al. 2007; Schure, Levang, et al. 2014; Khundi et al. 2011; Ainembabazi et al. 2013; Kinyanjui 1987). Small producers' agricultural practices are seen as being separate from charcoal production as it either competes for labour (full-time charcoal makers) or is framed as an ad-hoc activity that may only coincide with the agricultural off-season. As a labour intensive activity, smallholders are hypothesised to calculate the lost opportunity cost of diverting labour from agriculture to charcoal. Accordingly participation in charcoal markets can either be a full-time livelihood, or it can fluctuate with other "off-farm" job opportunities and cash cropping incomes (Townson 1995; Gandar 1992). For most authors this means that producers are positioned as full-time "charcoal makers" or "casual producers", rather than smallholders strategically diversifying their income (Chapter two; Jones et al. 2016). Thus despite acknowledgement that income from charcoal production feeds into agricultural practice (Zulu & Richardson 2013; Arnold et al. 2006; Khundi et al. 2011; Schure, Levang, et al. 2014), charcoal production and agriculture are seen as separate processes and little focus is placed on how they may interact to lead to forest loss.

2.1 Research approach and case justification

In order to understand better how agriculture and woodfuel production can be linked, this chapter places smallholder livelihoods at the centre of analysis, rather than a particular driver of forest loss. It therefore does not separate proximate causes, embedding them within the livelihood strategies of smallholders and charcoal producers. Smallholders manage land for more than one purpose, overlapping functions and land-uses (Rasmussen

& Reenberg 2015; Roth 2008). This argument is extended here to encompass the idea that a land-use change might have more than one motivation, rather than being a simple conversion from one land-use to another. In such scenarios, can we say that either charcoal or agriculture is the proximate cause of deforestation? Are they separable?

The link between small forest enterprises (such as charcoal production) and small farm enterprises is (re-)gaining prominence on the research agenda (Tieguhong & Schure 2015) with calls for an end to the analytical separation of agriculture and forestry (Macqueen et al. 2014). As such, analyses that try to holistically approach the practices of small farm and small forest enterprises are particularly timely.

Community A, as outlined in chapter two, is characterised by a considerable number of smallholders using charcoal as a livelihood diversification strategy. Production is predominantly occasional and, as shown later in this chapter, closely linked to their agricultural practices. As outlined above there is little research on smallholder and occasional charcoal production and therefore in this chapter Community A represents a revelatory case (Yin 1994), exploring a form of production that has received little academic attention. Whilst the form of charcoal production is always highly contingent on local political, social and ecological context, the findings can shed light on the ways in which conventional models of deforestation and degradation fail to address the connections between the small farm and small forest enterprises embedded within smallholder livelihoods.

The chapter proceeds as follows. Before returning to the primary case study, I first introduce a little bit of background relating to the separation of drivers within Mozambique. I then move on to describe how charcoal production and agriculture are linked within the case study area. Afterwards I explore the reasons behind the emergence of the link from a variety of perspectives. These perspectives are elaborated on within the discussion and used to draw conclusions about the implication of the case, its broader applicability and lessons for projects engaging with charcoal production as a driver of forest loss.

3 Case study: Smallholder charcoal production in Mozambique

Few studies in Mozambique try to quantitatively assess the contribution of different drivers to forest loss. The general assessment is that agricultural expansion and charcoal production are the main drivers of deforestation in Mozambique, with timber production and mining being regionally important (Drigo et al. 2008; Sitoe, Salomão & Wertz-kanounnikoff 2012b; Republic of Mozambique 2013). A study conducted in Manica Province, in an area similar to Community A, attributed 46% (±17%) of biomass lost to agriculture and 18% (±9%) to charcoal (Ryan et al. 2014).

At the national policy level, there is acknowledgement that drivers of forest loss "are interconnected and mutually reinforcing" (Republic of Mozambique 2013, p. 61), although there is very little by way of explanation about how these linkages play out – a common issue in land use change research (Hersperger et al. 2010). Within the Mozambican Forest Law, woodfuels are regarded as by-products of timber production (Plas et al. 2012). This has two implications: Firstly, holders of simple and concession licences for timber harvesting, are able to acquire a licence for woodfuel production more easily if the woodfuels are residues, or "by-products" of their existing operation (Decree 30/2002). Secondly, woodfuel production is restricted to less commercially valuable species.

There are differing charcoal production models across Mozambique. Broadly speaking, areas supplying the capital Maputo in the south are characterised by two commodity chains, one consisting of production by households and the other dominated by charcoal producers employed by an urban patron. In other parts of Mozambique, small-scale household production is thought to be more dominant, particularly around smaller-medium size towns and cities (G-32). Finally, charcoal production has been documented as a precursor to smallholder agricultural expansion in central Mozambique (Sitoe et al. 2000).

Within Community A, and as documented in chapter two, charcoal is made for a very diverse set of reasons, predominantly by households producing on a small scale. Producers range from women wishing for financial autonomy from their husbands, through to

households wishing for supplementary income from field opening. Those making charcoal have a wide range of livelihood strategies and cannot be simply labelled "the poorest", instead charcoal-making provides flexible opportunities for income for a wide range of households (Chapter two).

3.1 Methodology and data

In this chapter, the largest relative contribution of data comes from ethnographic work and qualitative interviews. 64 semi-structured and unstructured interviews were conducted with charcoal producers (n = 22) and other smallholders (n = 42) within the study area. Interviewees were obtained by walking transects out from three local trading posts. High rates of non-response (i.e. households were absent when visited), means this data is not treated as a random sample. Instead the sample was curtailed as a result of saturation (frequency that interviewees repeated the same things). Topics ranged from land-tenure and local politics through to agricultural practice and charcoal production. Appendix B contains examples of the questions used during these interviews.

Additional information on the link between charcoal production and agriculture comes from ten in-depth unstructured interviewees, randomly selected from respondents of the household survey outlined in chapter two. Data from the household survey is also used to document the number of households making charcoal and opening fields, as well as providing general information on factors motivating field opening. Table 3 details the data, scope and associated methods used within this chapter. For a detailed overview of the survey methods please refer to chapter two.

In addition, two focus groups were conducted, one in the form of a Participatory Rural Appraisal and the other in a more informal group interview setting. The first focused on the agricultural calendar, recent history and geography within Community A, whereas the second focussed explicitly on the rise of charcoal production and soya, the two major cash "crops" in Community A. Six life history interviews were conducted with community elders using narrative interview techniques (Bauer 1996), which focussed on how people made a living in Community A and what this meant for the landscape. Finally, this chapter also draws on data from relevant key stakeholder interviews including

full time and part time charcoal transporters (n=8), the local department of agriculture (n=5), the local government official for Community A as well as the local chiefs (n=5). Interviews were predominantly conducted in chiManyika and Portuguese. An interpreter was used for the local languages, translating directly to English. Following data collection, the qualitative data were analysed and coded for common themes within Atlas.ti 7.

Method	Data used in this chapter	Conducted
Ethnographic fieldwork	Field opening practices, land-use patterns and history, historical context, relationships between key groups, attitudes towards charcoal as a livelihood	Aug-Dec 2013
Interviews with households and producers, including narrative interviews	Forms and patterns of production, relative importance of charcoal production to livelihood, attitudes towards charcoal production, historical context of charcoal production, relationship between charcoal and agriculture as livelihoods and practices	Aug-Dec 2013; July 2014
Focus groups	Attitudes towards charcoal, types of production situation, gender and charcoal production, seasonal patterns of income	June 2014
Key stakeholder interviews	Perception of charcoal production amongst governing authorities, perception of production types, interventions into charcoal production	July-Aug 2014
Survey	Prevalence information relating to charcoal and charcoal practices, household characteristics	July 2014

Table 3 – Methods used, associated data and its application in this chapter.

3.2 How charcoal and agriculture are linked

Despite the prevalence of charcoal production and the comparatively high cash incomes it can provide, the majority of household survey respondents (>90%) listed their primary livelihood as being agriculture. Charcoal production functions as a complementary, diversification activity. Its production is essentially a function of its flexibility as a cash income source and thus households produce charcoal for a wide range of reasons (Chapter two). With the exception of a handful of producers who produced charcoal full-time, charcoal production was almost always framed through agricultural practice in interviews. Whether as a means of enabling extensification *("Every year you should increase your field. The purpose is to grow more and harvest more, if possible to sell."* (CA-6)) or as a productive way of utilising leftover biomass from clearance (*"Some of my friends were making charcoal and I thought it would be more interesting than burning the trees in vain"* (CA-5)).

Out of 114 households in the household survey who cleared land in the past year and subsequently planted crops on that land, 72 (63%) made charcoal with some of the trees.

Of these charcoal producing households 42 (58%) considered their primary motivation for charcoal production as being linked to the clearing of new fields. 80% of all charcoal producers sowed crops on part of the land cleared for production. There are some indications of a difference in agricultural strategy amongst producing and non-producing households (Chapter two). For example, 60% of households which planted purchased varieties of maize made charcoal, compared to 30% of non-producing households. Furthermore, household production of charcoal within the past five years is associated with an increase in cultivated area over the corresponding period[3].

Charcoal production peaks during field clearing from March to June (Chapter two). How land is cleared varies. Less than 30% of producers in the survey solely clear felled, with the rest either selectively cutting (28%), or supplementing clear felling with selective harvesting (42%). The latter is the most common approach within the study area: an area is clear felled and the kilns are then supplemented with additional trees felled from around this area. This creates an area of very high biomass loss, surrounded by an area of lower intensity loss. If clearance is followed by conversion to agriculture, this creates an area of deforestation surrounded by a strip of degradation. Only 16% of producers clear felled to produce charcoal and did not subsequently use the felled area.

Amongst the survey respondents, the most common reason for opening a new field was to gain access to good soil (75%). Respondents also report good soil as being the most important factor when choosing a new field (86%). However, there was no significant difference in field opening motivations between charcoal and non-charcoal producing households ($x^2 = 5.94$, p=.203). A third of the respondents consider whether the trees are suitable for another use (for example, charcoal production, construction or timber) when clearing new land regardless of the motivation for clearance. For households opening land *and* producing charcoal the most common combination of factors considered during clearance are soil fertility, tree type and proximity to existing fields.

Interviews suggest that charcoal finance contributes significantly towards agricultural

[3] Chi squared p=.008, Cramers v effect size = medium. Increase in field area self-reported by farmers categories: "increased", "decreased" and "stayed the same".

practice (CA-5; CA-6; CA-9; CA-23; CA-24) (e.g. "It can be impossible to get the money for seed without the charcoal" (CA-8)). The survey data shows that 20% of producing households produced charcoal to directly finance agricultural inputs, but without broader panel and income data it is difficult to determine quantitatively the extent that charcoal finance feeds back into agriculture (Chapter two). Charcoal "finance" also contributes in another key way towards agricultural practices: Households that did not have the labour to open a new field can find willing participants, often younger men or neighbours, who will clear land in exchange for a lion's share of the charcoal profits[4].

3.3 Why charcoal and agriculture are linked

3.3.1 *Positive feedbacks – fertility, cash and efficiency*

Smallholders within the study area open new fields in order to gain both finance from the charcoal and fertility from the soil. Farmers spoke of areas cut for charcoal as being good fields (CA-6; CA-7; CA-26), but pulling this apart from the benefits of using forested/fallowed land which has higher fertility after clearance is difficult. Interviewees reported that "the position with the ash is best, it is like it is fertilised" (CA-7) and a few farmers deliberately target the area under the kiln for horticulture for this reason (CA-5; CA-6). Other environmental considerations combine with a desire to not "waste" the trees from clearing land. This attitude stems from the fact that fewer (if any) trees and shrubs are burnt when fields are cleared alongside charcoal production, as the majority end up in the kiln. Interviewees spoke of avoiding the "unnecessary burning" of fields (CA-6), "wasting trees" (CA-28) and "burning in vain" (CA-29) echoing the lingo of NGO driven conservation agriculture, state agricultural extension programmes and the advice of a previous tobacco outgrowing scheme.

The soil fertility gains enabled by clearing new land combine with a reinforced justification for allocating the labour: cash. The availability of cash from charcoal making is shifting the way that farmers think about opening fields. Cash can feed-back from field opening into agricultural practice. For some households this enables the hiring of labour

[4] Older forms of reciprocal labour exchange also aid the process (on the importance of reciprocal labour in the Zimbabwe/Mozambique borders see: Moore 2005), but for charcoal production these are increasingly being replaced by profit sharing agreements.

during other parts of the agricultural season (CA-9; CA-16) or purchasing improved seed varieties (CA-8; CA-24; CA-28) (see also survey results presented in chapter two). The peak in production during the traditional period for opening fields (Chapter two) also suggests that households are optimising their use of labour by clearing for both agriculture and charcoal at the same time. Interviewees continually stated that the extra financial incentive from producing charcoal made field opening more attractive and justified the allocation of labour or enabled the hiring of labour (CA-5; CA-6; CA-21) (for example: "I can pay for help to clear the field because I know the money will come" (CA-30)).

3.3.2 *Charcoal as a contested livelihood*

Interviewees argued charcoal producing households sometimes open fields at a greater rate than they need to meet household requirements, or are capable of working:

> *"Last time, when people were cutting their fields, they cut where they were able, where they could work. Nowadays people can afford to cut more than they can work, this charcoal project is changing the environment, nearly every day."*
>
> (CA-18)

This form of link between charcoal and agriculture is contentious within Community A. In particular, the ongoing debate about households that open new fields every year is heated (CA-1; CA-2; CA-11). In one area, the annual meetings organised by the local traditional authority have been dominated by discussion on whether some households open a disproportionate number of fields when producing charcoal (CA-2).

In Community A, regular charcoal production without cultivation is viewed negatively. This perhaps ties into more general ideas about land-use, as in Mozambique leaving land "idle" is considered negative[5]. Fallow, forest and pasture are considered perfectly legitimate, but interviews frequently described cutting or clearing land and not subsequently farming as wasteful. Some interviewees justified this in terms of wasting the soil fertility from a newly cleared area (CA-18); others claimed more extreme scenarios where woodland would not grow back afterwards. This quote from an older lady living

[5] For a more detailed exploration of this idea in Mozambique see (Bowen 2000)

with her elderly mother is illustrative:

> *"You see this… I am refusing this land. They[6] want to take charcoal. If it is cut like that with no farming the land will not be fertile, even wood will not grow."*
>
> (CA-26)

Concerns about charcoal's impact on the woodland were common in interviews. Interviewees articulated the woodlands' importance in more than simple economic terms, linking its loss to drought and hardship for the whole community (CA-27) [7]. Environmental concerns about charcoal production's sustainability also align with concerns about the economic sustainability of the livelihood. Access to trees is predominantly confined to a family's smallholding creating a limit to the area that can be felled for production[8]. Frequently producing households were labelled as irresponsible due to the lack of economic future for this form of production:

> *"[If]I cut the trees, then stay… there is nothing else to do!"*
>
> (CA-6)

The local chiefs regularly refuse to allow charcoal production from outside households' existing forest areas – effectively banning charcoal production on communal land (CA-1; CA-2; CA-3). One chief also ruled that charcoal should only be produced as part of opening new fields (CA-2). However, the inability of the traditional authorities to enforce the regularity and volume of charcoal produced from trees within a household's smallholding was framed by interviewees as a major governance challenge:

> *"What people do – they exceed what the mambo says. [They open a new field] Every year! They open other people's fields, they add little by little to theirs…"*
>
> (CA-11)

Other interviewees argued that the process of allowing production on households' smallholdings was in itself problematic. In one of the oral histories conducted with an

[6] Her young neighbours wished to produce charcoal on her land whilst helping her open a new field. She was happy with the fields she already had.
[7] An argument heard elsewhere in Mozambique in relation to charcoal (McGregor 1995)
[8] Access to land with trees for new residents, families or those wishing to expand their area is currently not perceived to be a major issue within the study area (CA-1; CA-2; CA-10; CA-14 and focus groups).

elder they lamented the parcelling up of the landscape into small tenure blocks, evoking a 'tragedy of the anti-commons' by enclosure:

> *"Areas that were not owned were protected. Now it belongs to somebody he can use it in his own way; cut trees for charcoal…"*
>
> (CA-27)

and similar ideas were echoed by other interviewees:

> *"They have a bit, they have a bit, they have a bit… each person has his own portion of land where they can take what they own"*
>
> (CA-25)

Taken together these negative conceptions of charcoal production and its confining to households' smallholdings' encourages its linking to agriculture. In short, charcoal produced as part of a household's agricultural strategy is more acceptable. Broader themes highlighted within the interviews also help produce and reproduce the link between fuel and field. Traditional authority, elders and local government interviewees all expressed concern about smallholder expansion, arguing that changes in agricultural practices and cash-cropping, combined with charcoal production were leading to smallholders increasing their agricultural area, rather than concentrating on improving production from existing areas (CA-1; CA-2; CA-25; CA-27).

4 Discussion and implications

The framing of charcoal and agriculture as linked processes has a variety of theoretical and practical implications. In Community A, the link arises at the confluence between a range of factors. For smallholders, one time charcoal production followed by cultivation offers considerable financial benefits compared to managing areas for long term production (Bailis 2005). From an economic perspective the opportunity cost of field opening is significantly reduced when the "trees themselves make money" (CA-28). Within the case study a peak in production during the field-opening season, labour-for-charcoal exchanges and a local perception of accelerated field opening are all suggestive of this. The utility maximisation incentive combines with what Rasmussen & Reenberg (2012) might call an ecological rationality - opening new fields provides fertile soils. The

hard labour of felling trees makes such a proposition unattractive, but the cash income from charcoal softens this. Charcoal production also appears to enable some households to open fields more frequently for similar reasons. However the suggestion amongst interviewees that charcoal production is accelerating agricultural expansion is difficult to corroborate without a longer term picture of patterns of fallow and abandonment[10].

Income from charcoal feeds back into agricultural practice. Other studies using income data have reported much higher rates of re-investment of charcoal income of up to 90% (Schure, Levang, et al. 2014). Mather (2009), using national agricultural survey data, shows an increase in crop incomes of around 40% in central and northern Mozambique[11] amongst charcoal producing households. This suggests that the broader financial effects of charcoal production on agriculture are worth further study.

4.1 Implications for understanding deforestation and degradation

Within the case area, the separation of direct causes would be very difficult for smallholders opening new fields and producing charcoal in the past 12 months. Charcoal production and agricultural clearance interact in a variety of ways to lead to deforestation and forest degradation. Where woodfuel is genuinely a by-product of agricultural clearance the implications are important. Put simply, if forests would have been cut down anyway as a result of agricultural expansion, then projects engaging with woodfuels will not actually reduce forest loss. A recent analysis (Bailis et al. 2015), shows the significance of accounting for by-product into models of woodfuel supply and demand balance[12].

In Community A, farmers do clearly take advantage of the market, producing charcoal as a way to utilise the trees left from agricultural clearance. Yet the relationship extends beyond that of charcoal simply being a by-product of agriculture. Framing charcoal as a

[10] One of the few studies to consider charcoal production's impact on agricultural expansion (albeit in a very different context – the Peruvian Amazon) actually modelled the opposite, as allocating the labour for charcoal production slowed the ability of households to expand, thus reducing the overall cleared area (Labarta et al. 2008).

[11] Interestingly the relationship does not hold in Southern Mozambique, which might relate to the less close link between charcoal and agriculture in the South due to a stronger emphasis on specialised production.

[12] Due to the methodology used to spatially attribute forest loss events that lead to woodfuel as a "by-product" this model does not account for by-product from small scale clearance, only from large-scale deforestation events (Robert Bailis, personal communication August 2015).

by-product denies intentionality[13], an intentionality that is evident within the case study. Other authors have observed that charcoal can be the by-product of agricultural expansion and forest clearance at an industrial scale (Bailis 2005). Yet this framing of "by-product" is also complicated when finance from charcoal production is incorporated into the business strategies of forestry and biofuel companies (see for example: Portucel 2014)[14].

In some cases, charcoal may not be the motive for felling (or vice versa), but reinforces the motive. In this way it could act catalytically to accelerate field opening as argued by many interviewees in Community A. It is this mutual re-enforcing relationship that complicates the separation of drivers. Re-conceptualising the link between woodfuel and agriculture, to include not only "by-product", but the feedbacks between woodfuels, agriculture and other livelihoods would enable a more nuanced understanding of how these forces lead to forest loss. Refutations of the link between woodfuels and deforestation have long argued for a shifting of the blame to agriculture (Chidumayo & Gumbo 2013; Leach & Mearns 1988) without interrogating the implications of this. The sustainability of agricultural practice is a complex process, further complicated by the incorporation of woodfuel production. Seemingly subtle distinctions in practice are important because the mismatch between official accounts of woodfuel practices – the assumption at the local Agricultural Department is that charcoal is only produced by clear felling (G-10; G-13) - and what actually occurs have been fundamental for arguments focusing on the negative impacts of woodfuel production (Ribot 1999; Leach & Mearns 1988; Dewees 1989). The high levels of co-occurrence of agriculture and charcoal production, whichever way the relationship is approached, suggests that looking more carefully at the links will provide more nuanced conclusions.

4.2 The implications of co-occurring drivers

Resurgent interest among development organisations in woodfuel is leading to direct interventions into woodfuel commodity chains (Schure, Dkamela, et al. 2014). In its

[13] See: Vayda 2009 for a discussion on by-products and causal links in the social sciences.
[14] A new forestry concession a few kilometers from Community A will allow the local production of charcoal from trees cleared to make way for a Eucalyptus plantation.

current, albeit amorphous state, REDD+ (and related market based) initiatives are dependent on the ability to quantify proximate causes and link them to specific drivers (Salvini et al. 2014). The parsing of charcoal and agriculture into discrete drivers of deforestation underpins current modelling approaches, land-use classifications and the reporting of drivers within the policy processes on greenhouse gas emissions from land use change. Academic and project methodologies that enable the quantification of direct causes rely on being able to link discreet incidences of land-cover change to an individual driver (Ryan et al. 2014; Carodenuto et al. 2015), the success of which is highly dependent on the assumption that drivers do not co-occur at the level of the individual deforestation/degradation event. From this perspective, the case study provides a clear case of spatially overlapping proximate causes.

As well as little spatial separation between charcoal and agriculture, there is no clear separation of these drivers as practices. This means that carbon accounting methodologies for woodfuels, which currently assess emissions reductions using baseline scenarios of energy use, rather than land-use (Bailis 2009), would be invalidated by changes to agricultural practices amongst charcoal producing households. For example, how land is used post-production is arguably the key determining factor in whether deforestation or forest degradation occurs as a result of woodfuel production. Hence, whether deforestation occurs becomes a function of the agricultural practice of the household. Furthermore, whether the land remains permanently under cultivation (and thus deforested) may have little to do with the initial reason for felling. Changes in agricultural opportunities can lead to what might have once been original conceived as a field within a shifting cultivation system being switched to permanent cultivation, or an area cleared for charcoal, turned into field a few years later due to the ease of clearing relatively new growth.

A further example of a proposed intervention into charcoal markets that could benefit from this kind of thinking are agroforestry based land-sparing schemes, which are hypothesised as having potential as a woodfuel intervention (Minang et al. 2014; Iiyama et al. 2014). This case suggests that care would have to be taken to design schemes that overcame the considerable advantages of (continually) linking charcoal production and

field opening to swing the balance in favour of managing small forest lots. In addition, acknowledging the key role that social identity plays in motivating smallholder's charcoal and agricultural practices would be essential for positioning charcoal as a "valid" livelihood as part of such schemes. The seeming preference for agricultural livelihoods over charcoal producing ones in this study area means that any interventions need to pay attention to the way that certain livelihood practices are locally framed and governed.

5 Conclusion

Evidence from across Africa and beyond highlights the complexity of attributing deforestation to one possible facet of smallholder agricultural change (Temudo & Silva 2011; Grogan et al. 2012; Jansen et al. 2008; van Vliet et al. 2012; Geist & Lambin 2002). And, as shown by research on deforestation more generally, the processes triggering change can be complex, interacting and pushing in different directions. This chapter emphasises that in order to be able to apply such insights we need to go beyond simply documenting (and quantifying) "drivers" of deforestation and towards meaningfully articulating links.

As the case shows, woodfuel production and agricultural practice can be very closely linked. Smallholders within this study link charcoal to agriculture through the practices of land clearance, their labour, household finances and through charcoal's local governance. Care needs to be taken when framing charcoal as a by-product of agricultural expansion as it can belittle the catalytic role charcoal can play in field opening. Conversely the idea that agriculture simply follows charcoal production ignores the implications of this land-use change for future forest outcomes. This chapter has also highlighted how the link between charcoal and agriculture is not just borne out of necessity. The local perception of livelihood activities affects how people engage with them. In this case the negative views on full-time charcoal production could be argued to produce a form of production that is less sustainable by tying production to field opening (and therefore a land-use change).

Whilst not all woodfuel production occurs in such an intricately linked system as described within this case, the large volume of smallholders producing charcoal (the

majority of which are also farmers) across sub-Saharan Africa (Schure, Levang, et al. 2014; Kambewa et al. 2007; Shively et al. 2010; Sander et al. 2013) suggests that the way in which charcoal production and agriculture combine deserves consideration within assessments of forest loss.

Chapter four

The failings of formality: Charcoal market formalisation in Mozambique

1 Introduction

Producing, selling and trading charcoal contributes to the livelihoods of millions of people across sub-Saharan Africa (World Bank 2011; Zulu & Richardson 2013; Macqueen & Korhaliller 2011). The majority of this trade in charcoal and woodfuel is informal (Wood & Garside 2014). In Mozambique for example, informally produced charcoal is thought to account for 80-95% of annual consumption (Del Gatto 2003; Cuvilas et al. 2010). The informal nature of the market makes charcoal an important livelihood: Low barriers to entry and charcoal's flexibility as an occasional income source mean that in terms of numbers, charcoal markets are dominated by small producers, traders and sellers (Kinyanjui 1987; Kambewa et al. 2007; Kwaschik 2008). Participating in charcoal markets can act as a "safety-net" as cash-income opportunities fluctuate (Gandar 1992; Zulu & Richardson 2013); although charcoal can also be used as an important pro-active livelihood diversification strategy (Chapter two).

Like other informal markets, charcoal has long been thought of as a relic of underdevelopment and associated with environmental degradation and illegality (Mwampamba, Ghilardi, et al. 2013; Cline-Cole 1998). Over the past few decades these perspectives have encouraged policy neglect, production bans or attempts to encourage fuel switching (Arnold et al. 2006). In recent years however, interest in woodfuel issues has risen, driven by global climate change and forestry discourse (Zulu 2010), an interest in "modern" or "improved" biomass technologies (Cline-Cole 2007; Owen et al. 2013) and the importance of woodfuels in rural livelihoods (Schure 2014; Zulu & Richardson 2013; Arnold et al. 2006). Charcoal, these advocates argue, can be sustainable if it is managed as a renewable fuel (Arnold et al. 2006). This has led to the subtle re-framing of charcoal as a *potential* sustainable development opportunity (Zulu & Richardson 2013; Cline-Cole 2007).

The informality of charcoal markets is thought to be the key constraint to their sustainable management (FAO 2007); building formal institutions is therefore considered the best way to make charcoal production more sustainable (Schure et al. 2013). But as formalisation policies have been applied across Africa in a variety of natural resource governance settings (e.g. NTFPs, artisanal mining, timber), a growing body of research

has documented their negative affects (Spiegel 2012; Benjaminsen et al. 2009; Hirons 2011; Wynberg et al. 2015). Formalisation can have negative impacts by restricting market access or by benefiting more powerful actors (Ribot 1995) and often fails to empower small producers due to a variety of political, socio-economic and institutional factors (Spiegel 2012). Therefore, a key challenge is to understand how to recognise and allow for the benefits of informality, whilst enhancing sustainable practices.

In line with Schure et al.'s (2013) call for more empirical studies on the governance and formalisation of charcoal markets, this chapter looks at the continuing formalisation of the charcoal trade in Mozambique. Succinctly, this chapter argues that the framing of charcoal as an environmental problem leads to a continued drive for more stringent management plans and the exclusion of small producers from formal markets. In order to make this argument, the chapter starts by discussing informality and formalisation in relation to the wider charcoal and development literature. A Mozambican case study then follows. The case outlines the context of charcoal's formalisation in Mozambique and its governance as an environmental problem; before using empirical data from two regions of Mozambique to look at formalisation in context. By documenting the impact of regulatory changes in 2012 on charcoal markets (and in particular, small-producers' market access) the chapter provides a novel account of formalisation policies in practice. In the discussion that follows I analyse how current (environmentally focused) formalisation policies exclude small producers. In the final part of the chapter, I broaden this discussion to imagine how charcoal initiatives could better engage with informal producers and work to green informal charcoal economies, rather than focus on the top-down promotion of environmental norms.

2 Charcoal and formalisation

2.1 Charcoal as an informal economy

Informal economies [1] account for around three-quarters of all non-agricultural

[1] Whilst definitions and emphasis vary, research on informal economies generally encompasses the characteristics of enterprises outside of the formal economy as well as employment relationships that are not legally regulated (Chen 2007).

employment in sub-Saharan Africa (ILO 2002). Attitudes towards informal economies are highly variable (Chen 2007; Spiegel 2012; Putzel et al. 2015). They have long been characterised as a phase of under-development and framed by their links to illegality, whether that be tax evasion, unregulated enterprises or their role as an income source for criminality (Benson et al. 2014). These links lead to the common interpretation of informal economies as a form of avoidance, whether of taxes or regulation, leading to the criminalization of informality and attempts at its eradication (Sepulveda & Syrett 2007). Such economies have also historically been associated with environmental degradation as a result of activities such as illegal logging, small-scale mining and charcoal production (Benson et al. 2015). However, in recent years the important role that informal economies play in the livelihoods of the poor has been emphasised and their dynamic, innovative ability to respond to resource scarcity and economic turmoil highlighted (Tandon 2012; Benson et al. 2014).

These differing views on informal economies are reflected within the scholarship, policy and interventions related to charcoal markets. Charcoal markets are massive sources of employment, particularly in rural areas. Per TJ of energy consumed, charcoal is estimated to create around 200-350 jobs, a figure that is triple that of electricity and 20 times that of kerosene (World Bank 2005 cf. Mugo and Ong 2006). As a source of livelihoods this makes charcoal comparable in size to cash cropping (Matly 2000). The role of charcoal in rural livelihoods and its poverty alleviation abilities are increasingly recognised (Schure et al. 2014; Zulu & Richardson 2013) and recent research has emphasised the flexible role charcoal plays in rural labour markets, not only in-spite of its informality, but because of it (Jones et al. 2016; and Chapter two).

Informality though, can have its drawbacks. In the absence of formalised institutions, actors can have less authority within a commodity chain. This means they often lack agency to create better outcomes and consequently, they absorb more risks (Chen et al. 2004). This in turn can lead to inadequate working conditions and low wages (Chambwera et al. 2011). Informal charcoal markets are sometimes highly skewed, with vested interests maintaining control over the market, reducing the ability of other participants to benefit fairly (Schure et al. 2013). Other costs of informality for actors

include corruption and bribery, a feature common to charcoal markets (Smith et al. 2015; Ribot 1993; Zulu 2010).

But it is the perceived environmental cost of unregulated charcoal production that has dominated (and continues to dominate) charcoal policy and scholarship. The (informal) market, the prevailing narrative goes, fails to internalize the environmental cost of production into charcoal's price (Luoga et al. 2000), threatening the sustainability of the resource and its associated livelihoods (Chidumayo & Gumbo 2013). Thus at its worst, informality is thought to undermine and discourage those trying to manage resources sustainably, as formal enterprises struggle to compete with those not paying management and extraction costs (Wood & Garside 2014). This dominant narrative is not without its critics. However, informal charcoal markets have also been shown to respond dynamically to scarcity, adopt sustainable practices and have proven remarkably efficient at maintaining supply (Hiemstra-van der Horst & Hovorka 2009; Hansfort & Mertz 2011; Cline-Cole & Maconachie 2016; Cline-Cole et al. 1990).

2.2 Perspectives on formalisation

Although our understanding of informal economies is increasingly nuanced, the dominant perception is that a lack of regulation leads to inefficient and environmentally damaging resource use which provides few opportunities for economic growth (and therefore stifles development) (de Soto 2000). Within global development policy, the common consensus is that in order to deal with the problems associated with the governance and trade of natural resources, informal economies should be formalised (Putzel et al. 2015; Benson et al. 2015; Spiegel 2012). This is echoed within the literature and policy on charcoal with regular calls for formalisation and increased enforcement of existing legislation in order to ensure sustainability (Owen et al. 2013; Plas et al. 2012; Hofstad et al. 2009; SEI 2002; Sander et al. 2013).

Broadly speaking, formalisation is the design and enforcement of new rules of ownership, access and trade to replace informal ones (Putzel et al. 2015). It involves the codification of informal or customary rules and practices (Pacheco et al. 2008), often through state recognition and inscription. Formalisation is promoted for a variety of reasons including

poverty alleviation, conflict reduction, wealth accumulation and improving sustainability of extraction (Putzel et al. 2015). In environmental contexts, it is predominantly used to promulgate norms through state and non-state governance, often informed by overarching environmental discourses (Ibid.). Thus as a policy, formalisation normally entails a "top-down restructuring based on current social and environmental norms" (Putzel et al. 2015, p 453). Conversely however, it can arise as a collective, endogenous response amongst individuals and communities to develop governance mechanisms (Benjaminsen et al. 2006).

Formalisation of the woodfuel trade can take a variety of forms. States can control access to land and therefore production rights (Pierce & Burgener 2010). They can control the trade by defining quotas, fixing prices, licensing the traders and levying taxes (Ibid.). Or they can control production by licensing producers (Ibid.). Almost all of these measures are primarily conducted to conserve forest resources and to prevent energy scarcity (Ribot 1999; Zulu 2010). I will give a few examples: formalised land titles are thought to encourage longer term investments and therefore motivate sustainable behaviour (de Soto 2000); licensing producers means that the volume of charcoal and the manner in which it is produced can be controlled enabling greater resource planning; taxing production enables the internalisation of a market externality, as forest resources are framed as being "free" and their extraction not compensated for by producers (Luoga et al. 2000).

Although such measures primarily focus on enhancing environmental management, they also align with powerful narratives of modernisation and energy scarcity, as well as enabling the generation of substantial revenue (Ribot 1999; Zulu 2010; Cline-Cole 2007). Formalisation is seen as a necessary precursor to fostering private investment in "improved" or "more efficient" use of biomass fuels (i.e. for electricity generation, woodfuel plantations or briquette production) (Owen et al. 2013; Mwampamba, Owen, et al. 2013). Other actors can also benefit financially. Taxing the charcoal market brings substantial financial benefits to the state and in particular forestry departments. In Mozambique for example $55 million is foregone each year from non-enforcement of existing licensing legislation (LTSi 2015).

Finally, formalisation is also posited to better protect vulnerable stakeholders. For

example, under high commercial pressure, informal institutions may struggle to ensure sustainability and equity (Laird et al. 2010). If formalisation is accompanied by increased opportunities to participate in decision-making, it can enable rural actors to have more agency in terms of resource outcomes and gain a more equitable share, leading to positive outcomes in woodfuel management (Ribot 2009).

2.2.1 *The problems with formalisation*

As formalisation has arisen as a development policy, it has been shadowed by an increasing body of scholarship looking at its adoption and impacts. Research on formalisation within timber extraction, artisanal small mining and land rights have all documented the difficulties in achieving successful outcomes (Putzel et al. 2015).

During the formalisation process, not all the rights, interests and capabilities of stakeholders are considered, acknowledged, or understood (Putzel et al. 2015). This can lead to a variety of adverse impacts. Formalisation can restrict market access, benefit more powerful actors, reinforce existing inequalities and marginalize groups (Arnold & Perez 2001; Benjaminsen et al. 2006). For example, in Senegal the formalisation of charcoal markets enabled resource access for powerful urban traders at the expense of rural producers (Ribot 1995). Elsewhere in West Africa, formalisation has advanced urban actors along the value chain, enabling them to capture more benefits at the expense of rural actors (Schure et al. 2013). To understand the potential for resource capture and unequal accumulation by actors, the timing and motives of formalisation are important (Benjaminsen et al. 2009). Does formalisation benefit current land and resource owners? Does it occur at a moment of expropriation? Or facilitate other interests? (Putzel et al. 2015).

An under-acknowledged aspect is that formalisation itself carries inherent risks (Benjaminsen et al. 2006). In particular, poorer or small scale resource users can be marginalised by the complex institutional processes through which access is negotiated in formalised markets, leading to the benefits being unevenly distributed (Cousins 2009; Spiegel 2012). In a similar vein, charcoal legislation can "necessitate" criminal behaviour amongst small scale charcoal transporters due to the excessive rigidity of the law, leading to adverse impacts on their lives when legislation is enforced (Smith et al. 2015).

Enforcing new rules carries further risks. Whilst informal markets do often carry the burden of bribery, new rules can also create new opportunities for corruption (Tsing 2005). Stricter rules can also drive stakeholders to more environmentally destructive practices outwith the new system (Spiegel 2012; Putzel et al. 2015), leading to leakage.

In the worst cases, functioning informal institutions can be undermined by the new formal ones. Informal institutions are often more flexible than formal ones (Bensel 2008) and where use rights overlap, the formalisation of one over the other can lead to the loss of the alternative use and impoverishment of those relying on it (Benjaminsen 2002). Thus, whilst formalisation may be posited to give rural resource users more agency, where and by whom decisions are made matters. This hints at the relevance of decentralisation debates to formalisation. Local resource managers often lack discretionary power, despite practical management decisions being decentralised (Spiegel 2012; Ribot 2009).

2.3 Research approach and justification

Despite these critical perspectives, formalisation is still widely viewed as a key tool for improving the governance of forest products (Schure et al. 2013). Its mixed outcomes have been attributed to poor implementation, a lack of suitable legal frameworks and insufficient consultation with actors within the commodity chain (Laird et al. 2010). Such a view side-steps the idea that formalisation itself can be the source of the problem. Thus, there is a growing need for studies that engage with the complexities of formalisation (Spiegel 2012; Tschakert 2009), assessing its impacts and constraints (Schure et al. 2013), particularly for small-scale resource users.

Mozambique provides an interesting case study for charcoal production formalisation. Informally produced charcoal continues to dominate Mozambique's charcoal supply, despite over a decade of formalisation policies (Del Gatto 2003; Sitoe et al. 2012). This high degree of informality in the face of formalisation makes Mozambique's charcoal markets fairly typical, echoing other countries in east and southern Africa (Sander et al. 2013; Kambewa et al. 2007; Chidumayo et al. 2001). Like Tanzania, Kenya and Zambia (Sander et al. 2013; Wood & Garside 2014; Gumbo et al. 2013), this high degree of informality is attributed to lax enforcement and a lack of capacity at local governance

levels to facilitate compliance (Sitoe et al. 2012). Therefore formalisation is seen as vital for both reducing forest loss and ensuring the sustainability of charcoal livelihoods in Mozambique (República do Moçambique 2013; Sitoe et al. 2012). This environmental focus is present across sub-Saharan Africa (Neufeldt et al. 2015; Schure et al. 2013; World Bank 2010; Kambewa et al. 2007; Arnold et al. 2006).

Given the considerable importance of charcoal production for rural livelihoods in Mozambique (Cuvilas et al. 2010; Pereira et al. 2001) understanding the opportunities and constraints that formalisation brings - particularly for small producers - is vital. The criteria to assess formalisation used within this chapter are outlined in Table 4. To assess formalisation, following Schure et al. (2013), I first document the existence of written rules and policies dealing with charcoal commodity chains in Mozambique. I then provide a rare case-study of charcoal formalisation in practice, by analysing the impact of changes to Mozambique's charcoal licensing applied in late 2012. I document the impact of these changes by using licensing data and interviews along the commodity chain. The methods are described further in section 3.1.4.

Formalisation is often an incomplete process, one that is contested and morphed as it unfolds. Therefore, as well as documenting the impact of the regulatory changes on licensing, following Lowe (2005) I also look at the activation, application and interpretation of the law by authorities and the extent of their success. Finally, I outline the ease and accessibility of formalisation for small producers following the changes to the law. The case study therefore addresses the following questions:

- What is the nature of charcoal's formalisation in Mozambique?
- What was the impact of the 2012 reforms on formal and informal charcoal production in the two study areas?
- How has this affected small producers' market access?

The case study starts with a historical overview of forestry governance in Mozambique. I then move onto contemporary charcoal policy, discussing its underpinnings, before describing the current licensing requirements, outlined in 2012. I then introduce the study areas and the methods. These are followed by the results, which assess the impact

of the changes, their application in practice and their effect on small producers' market access.

	Assessed by:	Data
Status of formalisation	• The presence of written rules and policies relating to charcoal production (Schure et al. 2014) and their underpinnings. • The activation, application and interpretation of the law (Lowe 2005).	Document analysis, literature review, interviews
Formalisations impacts	• Changes in market structure and consumer prices • The application and interpretation of the regulations (Lowe 2005). • Ease and accessibility of formalisation(Schure et al. 2014) for small producers.	Licensing data, interviews, archival analysis of national newspapers

Table 4 - Criteria for assessing formalisation used within this chapter. Table 6 provides more details on the methods.

3 Case study: Mozambique

3.1 The governance of charcoal in Mozambique

3.1.1 *A brief history*

Charcoal gained importance in Mozambique in the late 70s and early 80s (BTG 1990; Falcão 2013) and has risen in popularity to become the main urban energy source in Mozambique (van der Plas et al. 2012). As with elsewhere in Africa, fears about energy insecurity caused by woodfuel-driven deforestation gained prominence in the 1970s (BTG 1990; Martins 2014). Following independence in 1976, the new socialist government (FRELIMO) declared securing woodfuel supply to urban areas a priority (Falcão 2013) and unsuccessfully tried to establish charcoal plantations around Maputo (Astorga et al. 1989; Saket 1994). However, despite a nationalised, centrally controlled forestry service producing woodfuel in the late-70s and early 80s charcoal production largely remained outside of state control (G-26; G-27).

Around major urban areas, households turned to charcoal production, as finding sources of cash income via the state farms or agricultural co-operatives became increasingly difficult (Yussuf Adam 1996) and as rural Mozambicans began to see "state institutions and policies as an obstruction to livelihoods" (McGregor 1998, p. 45). Unsurprisingly, a dim view was taken of informal charcoal livelihoods in both rural and urban areas.

Rurally, charcoal production was not well perceived by rural government officials, who claimed it undermined state promoted projects (Ibid.)[2]. In Maputo, tens of thousands of informal workers, including charcoal sellers, were forcibly relocated to state farms in the early 1980s (Fauvert & Mosse 2004; Hanlon 1991). During the later war years as resident rural charcoal producers were displaced by the fighting, young, marginalised men from urban areas replaced them, following FRELIMO's military deployments (McGregor 1997).

Following structural adjustment in the mid-late 80s, the forestry sector was de-nationalised and the Direcção Nacional de Florestas e Fauna Bravia (DNFFB) and the Serviços Provinciais de Florestas e Fauna Bravia (SPFFB) were created and tasked with the licensing and administration of forest products (Bila & Salmi 2003). However, despite environmental concerns dominating the debate on woodfuels throughout the 1980s and 1990s (Brouwer & Magane 1999; Pereira et al. 2001), the "licensing" of woodfuel production consisted of a simple stumpage fee. This fee was primarily enforced by roadside checkpoints (Dejene & Olivares 1991).

3.1.2 *The governance and formalisation of charcoal production today*

Today, whilst a variety of laws apply to charcoal production in Mozambique, its governance essentially falls under the remit of the Forestry Department (Plas et al. 2012). Community rights to land are provided within Mozambique's Land Law (1997). This law recognises traditional forms of tenure and encourages formalisation for communities, but does not define the use regime for resources on that land. For forests, this is governed separately under the Forest Law (Government of Mozambique 1999).

Enacted in 1999, the Forest Law represents the first significant effort to formalise Mozambique's forestry sector[3]. Alongside the Land Law it defines Mozambique's forests as the property of the state. Communities may use forest resources for their own consumption and convert forested areas to small scale agriculture, but commercial

[2] Despite this, it appears the FAO also had some success with promoting small-scale charcoal production as a source of "non-farm" income for rural communities (Tarp 1984).

[3] Following de-nationalisation in the late 1980s, stumpage fees, enforced by roadside checkpoints were collected (Dejene & Olivares 1991). But these efforts did not represent an attempt to outline conditions, or procedures for timber and woodfuel production.

exploitation must be licenced. Based on Marzoli (2007) the forest resources and their annual growth are estimated for each province, which is used to define an annual allowable cut which acts as a quota for forest licenses. The law defines two types of license: the simple license and the concession license. The conditions for these licenses were outlined in 2002, establishing a framework for the licensing of timber and woodfuel. Whilst most charcoal production is informal (Del Gatto 2003), when licensed, charcoal is primarily produced under the simple license[4].

Simple licenses are only available to Mozambican nationals and require a less rigorous evidence-based management plan than the concession license (Plas et al. 2012). Simple licences can be given to local communities, companies or individuals and no formal land rights are required for the production area. In contrast, concession licenses can cover larger areas, are available to non-Mozambican nationals and are procedurally more complex, in some circumstances requiring signing off at ministerial level (Ibid.). The simple license was originally designed to be a stepping stone for small Mozambican businesses on their way to acquiring concession licenses[5], the idea being that this would build capacity in the Mozambican forestry sector (Johnstone et al. 2004).

3.1.2.1 *Managing for sustainability*

Simple licenses have, since their inception, been subject to heavy criticism for facilitating access to timber for foreign interests and encouraging unsustainable logging (Mackenzie 2006; Nhancale et al. 2009). In both 2002 and 2012, the requirements of the simple license were outlined against a backdrop of a national/international scandal surrounding logging in Zambézia (Mackenzie 2006). Thus, as a response to criticism over its lack of sustainability (German & Wertz-Kanounnikoff 2012), the conditions of the license were substantially strengthened in 2012 (see section 3.1.3).

The environmental impetus behind the changes to the simple license put sustainability at the core of the new requirements, primarily by requiring an enhanced management plan.

[4] Charcoal production can be conducted under the larger concession licences, but this is very rare and tends to be a side business of timber production. Under such circumstances special dispensation is given for charcoal production (Government of Mozambique 1999).

[5] However, this idea has been superseded by the strengthening of license requirements in 2012.

Elsewhere, beyond the forestry sector environmental issues also dominate charcoal's governance (Plas et al. 2012). Agenda 2025, an umbrella document outlining the Mozambican government's long term development strategy, states it aims to: "substantially reduce the consumption of woodfuels [...], to prevent the already visible desertification in peri-urban areas" (Government of Mozambique 2003, p. 146). Reducing woodfuel production also features heavily in the environment ministry's action plan for reducing desertification (MICOA 2002). More recently, policy focus has shifted away from reducing and replacing charcoal, to engaging and enhancing its potential as a sustainable resource. In 2013, Mozambique adopted the ten year "Strategy for the Conservation and Sustainable use of Biomass Energy" (Estratégia de Conservação e Uso Sustentável da Energia da Biomass), which repositions woodfuel as a potential sustainable development opportunity. It aims to "improve the control system of the biomass value chain through a combination of measures to improve the sustainability of supply" and adopt "measures to change traditional systems into more efficient systems" (República do Moçambique 2013). These approaches are mirrored elsewhere: Mozambique's strategy for reforestation (República do Moçambique 2009) provides a framework to encourage private companies to create plantations for urban woodfuel supply and charcoal is increasingly positioned as a renewable energy source within Mozambique's energy department[6]. In short, as António José Amélia, First Deputy Speaker of the Assembly of the Republic highlights:

> *"Attitudes have changed: […] it is now widely understood that Mozambican charcoal must undergo a process to be transformed into wealth that can in turn help Mozambique."*
>
> (Chatham House 2015, p 2)

But whilst the economic importance of charcoal production and its role in Mozambique's energy future is leading to more constructive engagement with the sector (Martins 2014), sustainability is still the key organising theme. Referring to the current legislation in a funding request to the Forest Carbon Partnership Fund, the government describes the

[6] At the Mozambican Economic Forum in 2015 (MOZEFO), Antonio Saíde the then national director of renewable energy emphasised the role of biomass as a renewable energy source and its importance in Mozambique's future cooking energy supply (G-31).

current regulatory situation as follows:

> *"Although efforts have been made for the implementation of those legal tools, the results have not yet enabled the reaching of envisaged sustainability in the management of national forest resources. […] Non-sustainability in the production of biomass energy and illegal logging, including excess in harvested volume by licensed operators, is among the main drivers of deforestation and forest degradation. [...] No significant efforts have been aimed at reforestation and sustainable forestry practices in production areas have been identified."*
>
> (Government of Mozambique 2015, pg. 40)

This quote perhaps best highlights that despite the increasing emphasis on the importance of charcoal for rural livelihoods, discussion and action on charcoal in Mozambique is still dominated by its sustainability. Thus, as the Mozambican government looks towards forest sector reform once again (Government of Mozambique 2015), it is environmental priorities that continue to inform charcoal's formalisation, as they did in 2002 and 2012.

3.1.3 *The licensing changes in 2012*

The changes to the simple license in 2012 form the current backdrop to Mozambique's charcoal market today. Table 5 provides a detailed outline of the requirements for a simple license, as well as the differences between the 2002 and 2012 license. The regulation included specific requirements for charcoal production for the first time and requires a more complex forest management plan including a forest inventory. As part of the changes, basic cost per stere[7] for a license also increased by 500% from 10 MZN to 60 MZN.

Applying for a license can be split into three distinct parts, an initial application, a community consultation and an assessment by extension officers. After determining a production site, applicants produce an exploration plan, simple management plan and consult both the local traditional authority and the government official in charge of the local administrative post. The initial application is taken to the district agricultural

[7] A cubic meter of dry wood. This is a difficult measure to transfer to charcoal. Thus in practice a stere is widely interpreted as equivalent to one sack. Sack weights across Mozambique vary by up to 30 kg (Plas et al. 2012), making the measure problematic.

department (DDA) along with minutes of a community consultation. A topographic map of the area must also be sent to the provincial SPFFB, although it is the DDA's responsibility to determine if the land has been allocated to other users. Extension officers then visit the production site to verify and check an elaborated management plan.

	2002	2012
Basic conditions	• No specific conditions outlined for charcoal production • Renewable annually • 10 MZN fee per stere + 15% reforestation surcharge and district processing fee	• For charcoal production, up to 1000 steres a year from up to 500 hectares • Valid for up to 5 years • 60 MZN fee per stere + 15% reforestation surcharge and district processing fee
Initial application and exploration plan	• Map at 1: 50 000 in triplicate, including coordinates • The preliminary inventory indicated the principal species within the area • The estimate of the quantity, quality and nature of the products • The average annual amount of exploration • Description of the industrial and mechanical means to be used in the full exploration cycle	• Map at 1: 250 000 in triplicate, including coordinates • The annual quota for exploitation by species • The mechanisms for control and supervision of the activities in the licensed area • Proof of the operator's ownership of the felling, drag and transport means
Community consultation and benefits	• An indication of the number of jobs to be created and other benefits to local communities	• Minutes of a consultation with the local community signed by the chief and local government official • An outline of the contribution and benefits to the local communities determined by the consultation (including contribution in cash/building materials). This is only applicable to producers from outside the "local" community.
Assessment by extension officers	• Confirmation of the licensed area • A declaration of the species, class and diameters to be cut • Assessment of the operator's capacity to undertake the work	• Confirmation of the licensed area • Management plan, including detailed information on proposed silvicultural practices • Basic socio-economic data about the area and other sources of livelihood • Environmental and social impacts and means of mitigation, categorised into principal, medium and long term

Table 5 - Differences between the simple license (2002) and the revised simple license (2012) which cover timber and charcoal production. Based on Decree no. 12/2002, Decree 30/2012 and qualitative interviews (G-20; G-23).

After this procedure, the SPFFB grants a licence for charcoal production. A maximum area of 500 ha can be allocated for charcoal production under the simple license scheme. From this area 1000 steres of charcoal can be harvested annually. The license can be valid for up to five years. Community charcoal associations can form an umbrella group, with smaller nuclei associations to enable the individual nuclei to receive an allowance of 1000 steres. A fee of 60 MZN per stere is charged for each bag produced as well as a 15% reforestation surcharge. There is considerable regional variation as district governments are allowed to also levy a fee (Lei dos Órgãos Locais do Estado, 8/2003). By law, 20% of these fees should be channelled back to the community where the charcoal was produced. In addition, 50% of the value of fines paid in relation to various violations of the forestry law should also go back to local communities and law enforcement officers (GOM Forest Law 1999, Decree No. 12/2002). Charcoal is transported along with a "guia de transito", which documents the quantity of charcoal licensed, harvested and transported. This is checked by roadside enforcement officers.

3.2 The impact of the 2012 reforms

I now turn to look at the impact of these licensing changes. First I provide a brief overview of the study areas and my methods.

3.2.1 *Study areas*

Gaza province, situated in southern Mozambique, has the highest number of charcoal licensees in the country. Its northern districts are one of the main supply areas to Maputo (Luz et al. 2015). Charcoal production is an important livelihood across the province (Levy & Kaufman 2014), alongside agriculture and livestock raising (Baumert et al. 2016). Two types of production dominate: 1) production by resident households who concentrate their livelihoods on charcoal production and who access the market informally or through producer associations and 2) production by licensed large-scale producers who harvest an area before moving on, often backed financially by urban traders and investors. A bag of charcoal costs 250-300 MZN a sack in production areas (Baumert et al. 2016). The northern districts have a semi-arid climate with annual precipitation averaging 500 mm (INAM 2015). The province has a forest cover of around 50%, primarily consisting of mopane woodlands (Marzoli 2007).

Manica province is located in central Mozambique. Rural livelihoods across the province are primarily agricultural, however over the past decade charcoal production has grown to supply regional towns and cities, making charcoal an important source of diversified income (Jones et al. 2016; Chapter two). Charcoal is produced by both large-scale producers and occasional household producers. There are very few community charcoal associations. Charcoal costs between 60-130 MZN in production areas (CC-6; CC-7; CC-8; CC-9; CC-10). The province has a seasonal climate (wet-dry) with a rainfall averaging 1090 mm a year (INAM 2015) and is predominantly covered by miombo woodlands (Ryan et al. 2014).

The provincial level comparisons between the Gaza case and Manica case can be seen as broadly indicative of general differences between woodfuel markets in central and southern Mozambique. The use of two study areas allows a more holistic look at the impacts of the legislation and some comparison between the cases. More importantly it enables me to draw links between the regulatory changes at a national level and local impacts, by covering different forms of production and local governance context.

3.2.2 *Methods*

Semi-structured and unstructured interviews on charcoal governance were conducted at the national, provincial, district and administrative post level in both provinces. These are supplemented with commodity chain analyses from Mabalane District, Gaza (see Baumert et al. 2016) and three districts in Manica, which enabled the sketching of market structure. Commodity chain and licensing data from Gaza were not collected as part of this PhD and come from the project "Abrupt Changes in Ecosystem Services in Miombo Woodlands" (ACES) (Baumert et al. 2016). Some of the key stakeholder interviews covering Gaza were also collected as part of this project. Interview citation codes "CG" indicate these interviews.

In addition, licensing data at both the provincial and district level was collected for both provinces. Data is available from 2009-2014 across all licensed districts in Gaza and was provided, digitised, by the SPFFB. Information on the gender of the licensee was not provided, so a random sub-sample of 302 licensees (n=1414) was selected and gender determined from the name on the license. Data is available for Manica district in Manica

Province from 2011-2013 and provincial data is available for 2012-2013. Both data sets required digitization from original licensing receipts. A random sub-sample of 100 district level licenses (*n*=495) was digitised including the gender of the licensee (see also chapter two). The licensing data only provides a short window for direct comparison (2012-2013), but does cover a crucial period of forest governance reform. Thus reinforced with governance and key informant interviews it can provide important insights.

Finally, these data are put in context by key informant interviews and archival research of three Mozambican national newspapers. These are primarily used contextually and are supplemented by secondary literature. The data produced by the various methods and its coverage is summarised in Table 6.

Method	Data used in this chapter	Coverage	Conducted
Commodity chain analysis	Relationship between key stakeholders, governance and access to the charcoal market for producers, transporters and traders. Interviews with actors on their perception of charcoal governance. History of market structure.	Manica: Primary Case Gaza: Secondary Case	Manica: May-Jun 2014, November 2013 Gaza: Aug-Sep 2014
Focus groups	Role of charcoal within livelihoods, functioning of charcoal associations (Gaza only)	Producers Community A, Producers Secondary Case	Manica: June 2014 Gaza: Sept 2014
Key stakeholder interviews	Governance and regulation of the charcoal market, historical context of market development, sources and forms of production, licencing data and production statistics. Impetus behind the reforms.	Manica: Province and Primary Case Gaza: Province and Secondary Case	Manica: July-August 2014 Gaza: Aug-Sep 2014, Dec 2014
Key informant interviews	Historical context of Mozambique's charcoal market, drivers of change in the charcoal market, current impetus behind reforms and the relative importance of strategy documents	Maputo (1980s and 1990s)	Throughout 2014 and 2015
Archival research, national newspapers	Historical price data for charcoal and the causes of charcoal price rises	National 1980-2016. Better resolution post-2005 as the data was digitised.	2014 and 2016

Table 6 - Data types and range categorised by source method

3.3 Results

Following the reforms in late 2012, the cost of a license rose in 2013. In Gaza the price

rose from from 30 MZN to 75 MZN[8] (G-22; G-23; CG-4); Whereas in Manica the price per sack rose from 11.5 MZN to 69 MZN (60 MZN + 15% reforestation surcharge) (G-20; CC-16; CC-6; G-10). The impact of this rise was felt by consumers around the country as the increased costs incurred by producers were passed directly on to urban consumers. Price rises were reported in Quelimane (TIM 2013), Maputo (Iva 2013) and Nampula (Unknown 2013). In Nampula prices rose from 130 MZN to 200 MZN, whereas in Maputo prices rose from 600-650 MZN to 800-950 MZN (Unknown 2013; Iva 2013 May 1)[9]. Interviews also indicate short-term, small price rises in Chimoio, Beira and smaller towns in Manica province (G-13; G-33; CC-9; CC-10; CC-12; CC-13; CC-16). The implementation of the 2012 reforms were also followed by longer term changes in the amount of formal production and the structure of the market in both Manica and Gaza. These changes are outlined below.

3.3.1 *Formalisation in practice: Application, activation and enforcement*

3.3.1.1 *Gaza*

Following the reforms, the number of licensed sacks dropped from 420625 in 2012 to 207767 in 2013, a 50% decrease (Figure 5). The number of licensees also decreased by 6% from 282 to 264**.** The reforms impacted associations particularly strongly, contributing to their 90% decline in production over the past 5 years (Figure 6; CG-1; CG-3). The enforcement of the annual limit of 1000 steres per association nucleus, an increase in license cost from 30 to 75 MZN/sack and the introduction of the more stringent management plan, made the associations economically unviable (CG-1; CG-2; CG-3; G-22). This has largely removed this route to market for small producers. Interviews with Gaza's SPFFB suggest that in 2014 the management plan reverted to its previous simpler form, due to the difficulties in its implementation (G-23)[10].

In some districts, as enforcement is only conducted via roadside checkpoints, the license

[8] 10 MZN was roughly equivalent to 0.16 USD dollars at the time of writing.
[9] Following the changes in 2012, prices rose by 150 MZN/sack in Maputo as already produced charcoal was held in Gaza as officials would not issue licenses (Iva 2013). Producers then had to pay the increased fees stipulated by the new law in order for the charcoal to pass roadside checkpoints (CG-4). In practice, this just created a windfall for the SPFFB staff guarding checkpoints.
[10] This was cited as being an official government change in the licensing, however no evidence or corroboration of this could be found.

essentially functions as a *guia de transporte*, rather than a production license as the provenance of the charcoal is difficult to determine. Roadside enforcement officers gave mixed answers to their fining procedures, suggesting that enforcement is patchy (CG-8; CG-9; CG-10). Generally, enforcing management plans is difficult for the provincial department, despite the presence of community forest rangers at the district level. Rangers tend to have long distances to cover and are underfunded (G-23), which could make them susceptible to bribes and both the DDAs and associations generally lack the capacity to monitor temporal elements of the management plan (G-22). A major issue is that licensed producers frequently top-up their quotas by purchasing charcoal from informal producers (G-22; G-23; see also Baumert et al. 2016).

The declines in production following licensing changes are particularly pronounced given a reduction in licensed production in 2011. Prior to the reforms, concerns about the unsustainable nature of charcoal production in Gaza led to heavy restrictions on licenses at both the provincial and district level in 2011 (G-26). This led to a dramatic decline in licensed production (Figure 5). At provincial level the annual allowable cut was restricted, leading to only one license being emitted per person and a corresponding restriction in the overall volume per producer (G-26). The yearly average of sacks licensed for producers more than halved from 1446 ± 101 (SE) to 606 ± 50 (SE). Further restrictions also occurred across the province, with the district surcharge per bag of charcoal raised from 2 MZN to 5 MZN on top of the existing 30 MZN (G-22). In 2012, these licensing restrictions were lifted and production (and licence numbers) soared (Figure 5). Luz et al. (2015) attribute this to an increasing number of people entering the charcoal trade, rather than an increased registration of informal producers[11].

The lucrative nature of charcoal production and its perceived environmental impact has led to periodic struggles over the market between local, district and provincial authorities. In one district the local district governor added a further levy, by raising the processing charge from 2 MZN to 50 MZN, which he justified as a measure to combat deforestation.

[11] Analysis of the licensing data from Gaza shows that the increase in the number of license holders can be partly attributed to a rise in the number of female claimants. The number of licenses claimed by women quadrupled between 2011 and 2014 in Gaza and thus in 2014, women account for 40±6% of the licenses (±SE).

This exercising of discretion did not last long, as the provincial government challenged the legality of the decision (G-26). Whilst the fee was reversed at district level following this pressure, it was then re-applied at the (lower) administrative post level by a local government official before again being challenged and overturned.

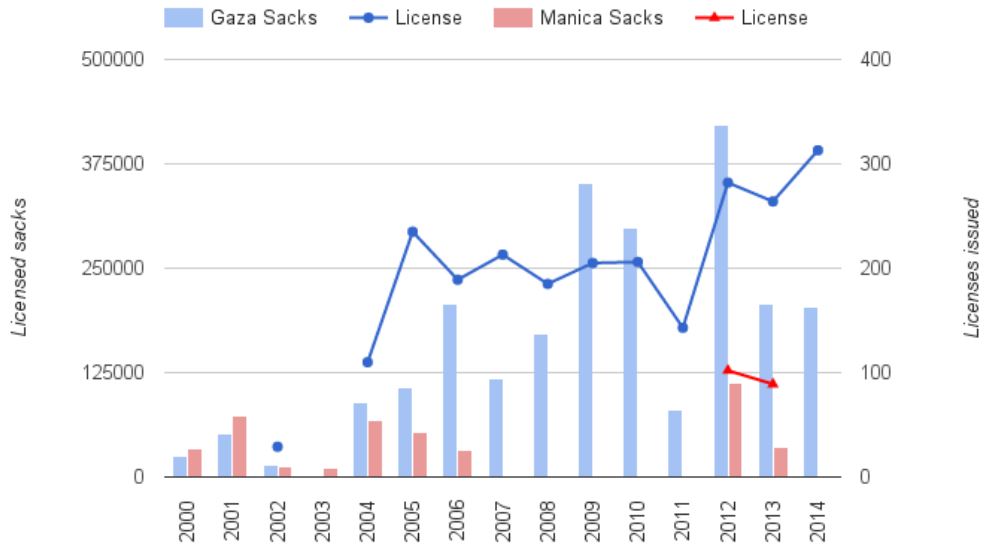

Figure 5 Number of licenses issued and the total number of licensed sacks for Manica and Gaza province. Lines should be read on the right hand axis, bars on the left hand axis.

3.3.1.2 *Manica*

Sack prices in Manica province are substantially lower than in Gaza province, meaning that the rise in license cost was felt more acutely. Analysis of the licensing data shows that the number of licensees decreased by 12% from 2012 to 2013 following the licensing changes (Figure 5). More strikingly, licensed production plummeted from 113,247 sacks in 2012 to 35,940 sacks in 2013. Formal producers were driven to supplement their formal production with informally produced charcoal, as the increased costs and enhanced management plans reduced profitability (G-20). Despite the drop in licensed production, the SPFFB substantially increased its revenue from 1.3 million MZN to 2.35 million MZN ($25,000-$45,000), due to the increased licensing costs.

Several districts across the province struggled to control charcoal production as the reforms made the licenses impossible to obtain for most producers. The immediate

impacts were apparent as some districts in Manica did not issue licenses in the months following the reforms as the costs were prohibitive for producers (G-11). As a result, some district authorities have reverted to the previous cost structure of the law (11.5 MZN per sack) and have removed the requirement for a management plan. This de-facto scheme therefore acts as a simple production tax. Under this de-facto licensing scheme, the DDA will issue licenses valid for one month, for up to 100 sacks a time. These arrangements are only available via district agricultural departments for small volumes of charcoal. None of the changes at district level appear to have a formal legal basis.

However, for larger producers, and in key supply areas for the provincial capital Chimoio, the law is applied broadly as written. This leads to a two tier regulatory scheme in the province where small producers produce through the de-facto scheme and larger producers under the de-jure licensing system. Larger producers still have to observe the annual license renewal, produce management plans and subject their license for approval at the provincial level (G-20). One exception appears to be that whilst the law stipulates management plans should be checked at the DDA, in practice they are checked by the provincial forestry department (G-13).

Assessing the degree to which the formal regulations are enforced is complicated due to the two tier regulatory scheme. At district level, no fines or confiscations have been applied in the history of the two district departments interviewed, which given the levels of informal production is indicative of 1) very low enforcement capacity or 2) corruption amongst monitoring officials. The majority of enforcement officers are based at the provincial SPFFB, rather than then the DDA (G-20). Enforcement tends to be at roadside checkpoints, rather than through visits to production areas (G-20; G-32). Producers and transporters said that fines were very much dependent on the enforcement officer (CC-1; CC-2; CC-6). In some areas covered by the de-facto scheme the absence of formal institutions managing (and enforcing) the sustainability of charcoal production, has led to traditional authorities stipulating conditions for production (CA-1; CA-2; G-18; G-19; see also chapter three)[12].

[12] The legitimacy of this is complicated. Breaking the conditions for charcoal production outlined in the

3.3.2 *Ease and accessibility of formalisation: Issues for small producers*

The de- facto licensing scheme adopted in some districts in Manica, enables more small producers to produce charcoal quasi-formally. The average license size issued per request is 23 ± 22 sacks, a scale of production that would be impossible under the de-jure scheme. This scheme still proves difficult to access for some producers given the distance to travel to the local agricultural department and a lack of communication about the rules (CA-5; CA-6; G-11; G-14). Some producers transport small quantities of charcoal on public transport under the guise of personal consumption (generally agreed at being roughly 5 sacks per person) to avoid licensing charges (CC-1; CC-2; G-15; G-20).

In Gaza, small producers rarely possess licenses due to the cost and bureaucracy of obtaining them (G-22; G-31). Producers are often unaware of how to acquire licenses for production and reported paying charges to authorities without knowing the purpose (CG-5). Producers reported being charged for the allocation of a production area by local community forestry officers – money which was channelled into the coffers of the local administrative post (CG-6).

The gaps between the formal licensing scheme, its application and producers practices, as well as the overlapping governance of the provincial, district and traditional authorities (who all say slightly different things) makes it difficult for producers to know under whose authority their production gains legitimacy (CA-5; CA-6; CC-4; CC-5). This fosters opportunities for corruption as producers are often unaware of their rights, or who is the legitimate authority to grant production rights. Generally, the changes in the law were poorly communicated, leading to patchy implementation and considerable confusion across both Gaza (G-23) and Manica (G-14; G-15). Interviewees expressed that getting information about procedures was difficult (CC-5; CG-7; CA-5). Other barriers to production include travelling to the DDA to obtain a license and paying in advance of production because "you never know what the kiln will provide" (CC-3).

The presence of community charcoal associations in some areas of Gaza has in the past

forest law would constitute a "crime against the state" (see: Kyed 2008) and therefore outside of the remit of traditional authorities. However, the de-facto licensing regime does not stipulate production conditions.

facilitated access to the formal market. The majority of associations in Gaza were created primarily through non-government interventions on climate change (Eucker & Reichel 2012), although NGO support was withdrawn in 2011. Whilst they produce less charcoal than other forms of producer (Figure 6), they can in theory provide market access to a large number of small producers, increasing their capacity to engage with existing legislation. However, the rule changes in 2012 and a lack of capacity within the associations to organise nuclei, means that association production has dropped (Figure 6). Small producers now mainly access the market by selling informally to larger license holders (Baumert et al. 2016) a process also witnessed in Manica. A side effect of this is that much seemingly "licensed" charcoal rarely comes from the area stipulated in the license (Ibid.), undermining the imposed sustainability criteria.

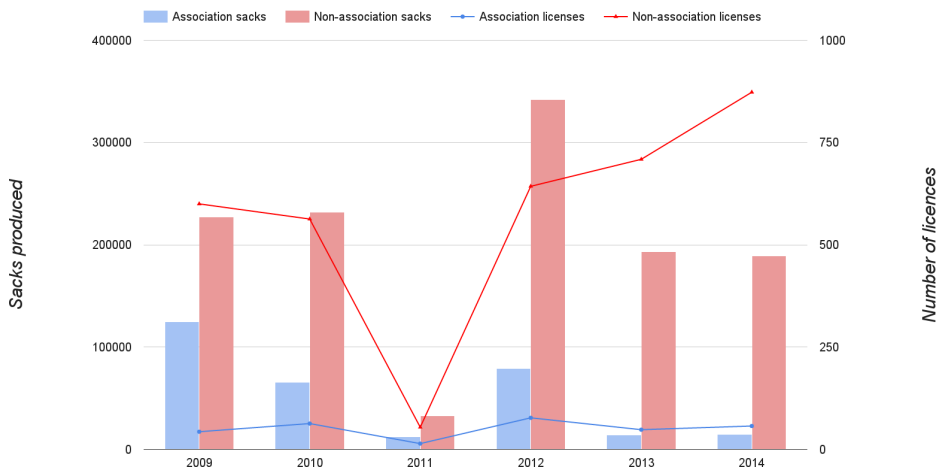

Figure 6 – Charcoal produced by associations in Gaza, compared to charcoal produced outside of associations.

4 Discussion

The results from Manica and Gaza show the fragmented reality of charcoal formalisation in Mozambique. Since 2012, the formal market has shrunk in Manica and Gaza, with the licensed volume of production decreasing in both provinces. This suggests that, given stable demand and available forest resources, production has increased within the informal market.

The reforms have not only affected producers; they also been felt by consumers. Large price rises were reported in several major Mozambican cities following the reforms. In Gaza, struggles over releasing already produced charcoal led to associated price rises reported in Maputo (Iva 2013). This adds to the evidence that scarcity in charcoal markets often results from political struggles and misguided intervention, rather than resource scarcity (Zulu 2010; Dewees 1989).

Generally, applying the 2012 licensing changes has been difficult. The regulations are currently only partially applied in the two study areas. In order to continue to issue licenses, local authorities in Manica have abandoned forest management plans and reduced the licensing cost below that written in the law. The operation of de-facto licensing schemes that essentially constitute a transport (rather than production) license, not only reflects a lack of capacity but also the unsuitability of the current legislation for the on-the-ground reality. In both provinces, the relaxation at both district and provincial levels of the required forest management plan shows this has been a major obstacle to implementation. In short, the application of the costlier and more procedurally complex license in 2012 appears to have driven formal producers into the informal sector. Thus despite attempts at formalisation and the outlining of conditions for sustainable forest management, the charcoal licensing scheme is broadly the same as the 1980s: enforcement by roadside checkpoint of de-facto transport licenses.

Echoing the literature outlined in the opening stages of this chapter, the results show that formalisation presents a variety of hurdles for small producers. I look more closely at how these producers are excluded in the discussion that follows. I then draw on the case study to show how the framing of charcoal as an environmental problem (as outlined in section 3.1.2.1) and a linked bias towards professionalised, large-scale modes of production make inclusive formalisation difficult in Mozambique. I argue that this represents not only an implementation gap, but a fundamental issue with formalisation focussed on environmental protection. In the final section of this chapter, I suggest that to move beyond the current impasse in the governance of Mozambique's charcoal sector, approaches to the market need to engage constructively with informal producers.

4.1 Privileging the professionals: Why formalisation excludes small producers

The legal framework for forest management in Mozambique is often described as being progressive, but undermined by an enforcement deficit or implementation gap (Plas et al. 2012; Del Gatto 2003; Sitoe et al. 2012; Wertz-Kanounnikoff et al. 2011). This positive framing is mainly due to its community based natural resource management underpinnings and the transfer of benefits to local communities embedded within the widely praised Land Law. There is a sharp contrast though between the Land Law which transfers use rights to communities and the Forest law which undermines these rights by restricting access to the land's resources to subsistence levels. The structure of the license laid out in the Forest Law effectively levels the playing field between larger charcoal producers, community based associations and small producers.

By ignoring differences in capacity between types of producer, the law favours formal, large scale enterprises. It requires that small producers behave as if they were large companies: Community associations managing diverse interests and rooted in local politics are expected to compete with private businesses on a level playing field. Small producers are required to pay the same fines for breaking management plans, cover the costs of visits by SPFFB officials and provide financial benefits to the community. An addition hurdle is that the highly technical regulations are only outlined in district agricultural departments, in Portuguese (rarely spoken in rural areas) and often a long journey away from production areas. The problems with formalisation stem not only from the high costs and minimal benefits, but from the difficulties of complying with the arduous rules.

It is hardly surprising then, that despite the continued drive towards formalising Mozambique's charcoal markets, large numbers of informal producers remain (Del Gatto 2003). Compliance with the requirements of the simple license is too complex and costly except for the most organised, professional and well-financed producers. This link between professionalization and formalisation is entrenched within the governance of charcoal for two key reasons. Firstly, such enterprises are easier to monitor and bring in considerable tax revenue (the de-facto two tier licensing scheme in Manica serves as a good example). Secondly, the blueprint for a modern and sustainable charcoal sector is

one predominantly built on efficiency, modernisation and scale (Cline-Cole 2007). As Cumbe et al. (2010) note, the state is seemingly only interested in large-scale production, an observation that is backed up by Mozambique's policy documents (República do Moçambique 2009; República do Moçambique 2013).

In its original incarnation, the simple license was conceptualised as a way of building capacity in the Mozambican forest sector (Johnstone et al. 2004). The focus on scale and professional practice in the licensing law reflects this view. But not all small producers are future specialised participants in a formal charcoal market. Envisioning formalisation as corresponding to an increasing professionalization of smaller producers may be a fundamental misunderstanding of the diverse roles that activities such as charcoal production and artisanal mining take within rural livelihoods. Although avoiding costs and regulations is important for informality, the productivity of informal producers is often too low for them to prosper within a formalised market (La Porta & Shleifer 2014). Flexibility is a key factor underpinning the importance of charcoal production in rural livelihoods (Jones et al. 2016; Chapter two), a factor missing from the current licensing scheme. Thus it is perhaps questionable that reductions in costs would encourage formalisation, as advocated by De Soto (2000).

4.2 Scalar challenges in Mozambique's charcoal market

For the moment however, there is currently an impasse between a rigidly defined view of formalisation that favours large-scale production models and the reality of charcoal production, largely conducted by small-scale producers unable to meet the requirements of the law. This is perhaps best illustrated in Manica, where in the face of unenforceable and untenable legislation local agricultural departments have applied a de-facto licensing scheme. In effect, the province now operates a two-tier licensing system where small producers can purchase quasi-formal licenses and larger producers are taxed heavily through the existing regulation.

However, in both Manica and Gaza, larger scale producers supplement their licensed production by trading informal charcoal produced by smallholders (G-20; G-13; see also: Baumert et al. 2016). This enables larger producers to top-up their trucks with charcoal

from outside of their defined licensed area, undermining the way in which sustainability is monitored through the formal license scheme. Similar forms of practices, where formalised producers become reliant on informal production, have also been observed in other informal markets (Putzel et al. 2015). Whilst such a relationship between informal and formal production could be framed as undermining sustainability (Wood & Garside 2014), it is important to see this relationship in context. By selling to larger producers and traders, small-scale and occasional producers can gain market access, helping to subvert the bureaucratic, financially demanding and inflexible licensing scheme.

One way of bridging the gap between the requirements of the licensing scheme and the capabilities of producers, is through associations (Nhantumbo et al. 2013). However, the changes in the licensing law in 2012 have made the charcoal associations in Gaza economically unviable. Furthermore, in Manica, a lack of local forest sector capacity, predominantly occasional production (rather than full-time) and the high cost of a license also provides a barrier to associations. The formalisation of charcoal in Mozambique has established a regulatory framework that effectively requires local collective action, yet has imposed restrictions which make such action difficult. This acts to exclude small producers from the formal market.

4.3 The environmental framing of the charcoal problem: A key barrier to reform?

As seen in section 3.2.1.1, governance of charcoal production in Mozambique is firmly situated in an approach that places environmental concerns first. The current legal framework, Mozambican Biomass Energy Strategy and plans for reform all emphasise two key things: Firstly, a lack of sustainability within charcoal production and secondly, that informal/illegal production is a key source of this unsustainability (Del Gatto 2003; Bila 2005; República do Moçambique 2013; Republic of Mozambique 2013)[13].

Without consideration of the ways in which charcoal markets are formalised, governed and restructured according to environmental imperatives, interventions are arguably

[13] Whilst I traced this emphasis in the first section of the case study, finding the root of it is more difficult. The situation of charcoal governance within forestry departments, global narratives on environmental degradation, colonial attitudes towards resource management, the extrapolation of localised deforestation across wider areas and a neo-classical view of how woodfuel markets function all contribute (Cline-Cole 2007; Ribot 1999; Hiemstra-van der Horst & Hovorka 2009; Hansfort & Mertz 2011).

going to continue to marginalize informal producers through increasingly stringent forest management plans. Along with the licensing fees, producers emphasised that it is these management plans that are the key barrier to their involvement in the formal charcoal market (CC-2; CC-3; CC-14; CC-15). In Manica and Gaza the management plans seem to have largely reverted back to older, simpler versions due to producers' inability to comply with the regulation. Thus, this research reinforces existing studies documenting the patchy application of simple license management plans within Mozambique's forestry sector (German & Wertz-Kanounnikoff 2012; Ribeiro & Guedes 2012; Salomão & Matose 2007).

The management imperative has deep roots in the idea that woodfuel markets are not capable of maintaining supply, are inequitable and inherently unsustainable – attitudes continually questioned over the past decades (Cline-Cole & Maconachie 2016; Cline-Cole 2007; Ribot 1999; Hiemstra-van der Horst & Hovorka 2009). Contrary to the prevailing narrative, the charcoal market is remarkably efficient at suppressing consumer prices and meeting demand (Leach & Mearns 1988; Cline-Cole & Maconachie 2016; Neufeldt et al. 2015; Schure 2014) and generally, policy makers and academics have long underestimated the ability of woodfuel markets to respond and adapt to needs (Cline-Cole & Maconachie 2016; Hansfort & Mertz 2011). This is not to say inequities, unsustainability, mismanagement, price fluxes and vested interests do not exist within charcoal markets. In some places they clearly do (see for example: Ribot 1993). Yet despite continual pleas for context, approaches to charcoal have adopted a one size fits all, environmental governance blue-print. As with other areas of sustainable forest management:

> *"The imposition of homogeneous legal frameworks by the state does not take into account the diversity of local realities and often neglects the existing working rules for forest resources use adopted by smallholders and communities."*
>
> (Pacheco et al. 2003, p 3)

In Manica we can see evidence of this. The adoption of the de-facto licensing scheme reflects the inability of the current framework to account for context. District level

authorities in Manica are adapting by applying de-facto licensing schemes, but these are currently little more than state rent capture, and are not being used to increase the sustainability of charcoal. Despite these steps, the DDAs continue to be little more than passive collectors of revenue: The de-facto licensing scheme seemingly has no legal basis and the struggles over the licensing levy in Gaza (section 3.3.1.1) show just how difficult it is for district authorities to exercise meaningful discretion, a vital power for democratic, decentralised resource management (Ribot et al. 2010)[14].

The application of homogenous legal frameworks is also problematic when it comes to define criteria for charcoals sustainability. State driven formalisation differentiates between illegitimate and legitimate activities and attempts to bring legitimate activities into the formal sector. As the predominant focus of the licensing system is sustainable forest management, legitimacy is currently narrowly defined as the ability to meet certain sustainability criteria through forest management plans. The forest management plans within the simple license are entirely based on large scale (industrial) models of timber production. Firstly, this further biases production towards larger-scale models[15]. Secondly, this raises questions on their suitability to engage with the reality of charcoal production.

Across different contexts, the sustainable management of charcoal might mean different things. For example, in some areas of Manica, faced with an absence of formal sustainability criteria, traditional authorities are stipulating conditions for charcoal production, allowing production as part of field opening for smaller producers (see also Chapter three). This could be considered an efficient low carbon use of land and trees. However, the Forest Law excludes informal/traditional institutions from efforts to formalise and govern forest products and thus their decision lacks formal legitimacy.

[14] In this regard, the increasing alignment in Mozambique between climate change and charcoal production goals could be problematic (Government of Mozambique 2015; Government of Mozambique 2010). Emerging debates on how deforestation governance is reshaped and partly recentralised by initiatives such as REDD+ (Agrawal et al. 2010; Wunder 2010), may have important implications for informal charcoal livelihoods if local authorities cannot exercise discretion in the face of rigid environmental rules.

[15] Yet, even for Mozambican timber producers the requirements of the new management plans were also deemed too strenuous. The representative body for the timber industry in Mozambique, AMOMA (Associação Mozambicanos de Operadores de Madeira), unsuccessfully requested a moratorium on the new management plans arguing it would lead to up to 50,000 job losses (Anon 2013).

Again this highlights the differences between the Forest and Land Laws, as the Land Law enshrines legal pluralism by affording traditional authorities some discretionary powers (Buur & Kyed 2005; Madison 2010). Given that incorporating informal institutions and existing woodfuel management schemes into interventions can lead to more sustainable outcomes (Bensel 2008), an important future step could be to look to existing institutions, rather than using formalisation to impose forest management norms.

Thus regardless of the approach taken, identifying suitable interventions for the informal sector will require the input of a wide range of views from stakeholders and will need to be mindful of the highly contextual nature of charcoal markets. Without this, the criteria which define legitimate production will continue to be narrowly defined and will tend to be driven by forestry sector interests, rather than a more plural range of views. A one size fits all model of sustainability is always going to be liable to exclude some actors, in this case it is small producers.

4.3.1 *Greening an informal economy*

The results of this study show that forest law reform in Mozambique is currently excluding small producers from the formal market. The imperative to control sustainability by complex management plans and institutional arrangements is having little success at bringing informal producers into the formal sphere – which is stated as being key to reducing forest loss (República do Moçambique 2013; Republic of Mozambique 2013). This is not just an implementation gap. Increased enforcement will further exclude producers from the charcoal market. Reconciling the gap between the licensing scheme and individual producers by promoting collective action through community associations and linking SMFEs (Nhantumbo et al. 2013; Macqueen 2014) can enable some small-producers to access the market. But the cases presented in this chapter suggest that the link between formalisation, sustainable management and professionalisation needs to be broken to engage smaller producers. Rather than organise small producers to meet the requirements, approaches should look to make sustainability requirements better fit the reality of small producers. To put another way, given the importance of informality for charcoal livelihoods (Chapter two), it is useful to consider how informality can be better engaged with and allowed for.

As the literature documenting the gap between the theory and reality of formalisation grows, there are increasing calls for active engagement with informal miners, loggers and sellers of forest products (Spiegel 2012; Putzel et al. 2015; Benson et al. 2014). A particular concern is that if environmental protection and formalisation go hand in hand, this will come at the expense economic diversity (Chen 2007; Benson et al. 2014). In short, the question being asked is: Can informal be green?

Rather than submitting the charcoal market to top-down restructuring through changes in licensing requirements and costs, policy approaches could incentivize sustainable production for larger producers whilst maintaining flexibility for smaller, occasional producers. Soft-touch, gradually introduced regulation, a reduction in the cost and difficulties in obtaining a license and incentivizing sustainable practices through tax-breaks could all be beneficial steps for specialised producers. For small-scale producers, initiatives that encourage sustainable practices and locally driven land-use planning, whilst maintaining the ability for flexible (informal) production might be one way forward. First and foremost, however, including informal producers when defining the aims and outcomes of charcoal interventions is vital.

There are precedents for such an approach towards the charcoal market elsewhere in Africa. For example, Kenya's recent approach of working directly with informal networks and local enterprises by incentivising community-driven afforestation might offer some pointers (Wood & Garside 2014). In particular, devolving responsibility for resource management to more local levels (combined with discretionary power), incentivizing sustainable production and engaging with existing informal institutions can enable charcoal markets to continue to provide livelihood benefits whilst moving towards sustainability where resources are scarce (Ribot 2009; Schure et al. 2013; Bensel 2008). Further lessons on engaging with informality may also be gleaned from the literature and experiences on the governance of artisanal mining and NTFPs which are increasingly proposing approaches to informal markets that do not necessitate formalisation (Spiegel 2012; Hirons 2011).

5 Conclusion

Calls for the increased enforcement regulation and the elimination of unlicensed production of "illegal" and "illegitimate" forms of charcoal production (Miranda et al. 2010; Sander et al. 2013), portray the law as an unproblematic tool for implementation, leading to depoliticised accounts, lacking empirical analysis of the real impacts on rural economies. This chapter has attempted to counter this trend within the charcoal literature by showing the negative impacts of formalisation. These impacts have stemmed not only from its implementation, but because of its underpinning logic.

The construction and representation of woodfuel issues determine the solutions that are available (Cline-Cole & Maconachie 2016). By focussing on environmental concerns, the governance framework and formalisation process is creating conditions that exclude the majority of charcoal producers. This is not solely an issue of marginalising certain types of charcoal production. The continued inattentiveness of environmentally driven resource management to the importance of informal charcoal production in rural livelihoods undermines sustainability by enforcing interventions that exclude small-producers from formalisation. Driving formalisation via new regulations and standards will continue to exclude small producers if the requirements continue to be strict and discretion cannot be exercised at the local level.

Charcoal plays a vital role in rural labour markets, not in spite of its informality, but because of it. Mirroring the literature on artisanal small mining (Tschakert 2009), there needs to be a move towards seeing small scale charcoal production as a livelihood strategy that should be 'nurtured' and given space to 'flourish'. Thus a key challenge to creating sustainable charcoal markets rests on finding mechanisms to engage with small informal producers that can account for the diverse ways charcoal is used in livelihoods. As with the broader literature on formalisation, this chapter suggests that engaging directly with informality and acknowledging its logic and local context is vital.

Chapter five

Synthesis, reflections and conclusions

1 Synthesis

Set against the backdrop of increasing interest in the importance of charcoal within rural livelihoods (Ribot 1995; Schure et al. 2013; Zulu & Richardson 2013; Smith et al. 2015), this thesis has explored informal, small-scale charcoal production in Mozambique. Braided through this research has been an interest in the friction between informal livelihoods and environmental sustainability. This friction is particularly acute when considering the livelihoods of small-scale and smallholder charcoal producers.

In the three empirical chapters I have offered answers to the three research questions:

- What is the role of charcoal production within small producer's livelihoods?
- What are the implications of the role of charcoal production within small producers' livelihoods for understanding forest loss?
- What is the relationship between informality/formality and small-scale charcoal producers' livelihoods?

In this final chapter I look again to these research questions and broaden my arguments. I synthesize the results of the empirical chapters, looking at the key themes of this thesis: small-scale charcoal production, environmental concerns about charcoal production and charcoal market informality/formalisation. In doing so I tie the findings to the literature, provide reflections for future research and explore implications for future engagement with charcoal markets. Throughout I link back to the analytical approach of this thesis, reflecting on its use. The chapter consists of two main sections. The first section starts with a synthesis of the findings about the livelihoods of small-scale producers; continues by looking at current debates about woodfuel governance and formalisation and then finishes with a discussion of implications for woodfuel interventions. The second section discusses my analytical and methodological approach, alongside recommendations for future areas of research. The chapter finishes with a general conclusion to the thesis.

1.1 Charcoal livelihoods: The implications of diversity and production scale

Throughout the empirical chapters of this thesis the picture of small-scale charcoal production that has emerged is one of diversity and flexibility. To summarise: producers within the study area make charcoal in a wide variety of situations (Chapter two), linking

it to other livelihoods (Chapter two; Chapter three). Charcoal production is particularly closely connected to agricultural practice. This takes a variety of forms ranging from financial feedbacks through to the physical practices of land clearing (Chapter three). I have also highlighted the multi-faceted nature of charcoal production and the variety of social, political and economic factors that underpin it (Chapter three). Charcoal is a versatile but contested form of income, shaped by environmental debates, negative perceptions and variegated market structure and governance at district, provincial and national scales (Chapter three; Chapter four).

This exploration of diversity has been facilitated by insights from the literature on NTFPs. The findings are broadly in line with the NTFP literature on African/miombo woodlands, which emphasises the range of important roles that woodland products can take in rural livelihoods (Hedge & Bull 2008; Dewees et al. 2010). Furthermore, in line with re-appraisals of the impacts of NTFPs on forest resources (Neumann & Hirsch 2000), in chapter three, I also make the link between the specific practices of producers, varying livelihood role of the product and the potential impact on forest resources. These findings contrast to previous work on charcoal that has emphasised its role as a specialised livelihood strategy (Chavana 2014; Bekele & Girmany 2013; SEI 2002).

As demonstrated in this thesis, being aware of and sensitive to differing types of producer matters: How woodfuels can contribute to rural development goals is contingent on the role of charcoal production within a producer's livelihood[1]. Thus, as woodfuels begin to (hopefully) receive more of a livelihood focus, understanding outcomes for differing groups of stakeholders is important. Here I have predominantly focused on outlining a case for 1) understanding diversity amongst producers and 2) focussing on smaller stakeholders. Future research can benefit from disaggregating types of stakeholder whether that be by forms of production, gender or wealth (Smith 2016).

To work through one such example. Research on high value NTFPs (Sunderlin et al.

[1] In a similar vein to arguments contained in this thesis, Martins (2014) argues that the literature frames producers as either "opportunistic forest managers" or "passive victims of poverty" (pg. 20). Informed by these caricatures, approaches to woodfuel either privilege a utilitarian view of the resource, emphasising its productive capacity for poverty alleviation or CBNRM perspectives that stress one-dimensional views of conservation and encourage a movement away from livelihood strategies that include woodfuels (Ibid).

2005; Angelsen et al. 2014) resonates with recent findings from charcoal markets (Schure 2014), to suggest the poorest households struggle to capture substantial benefits from high value forest products. For charcoal markets access approaches are informative in this regard, showing the processes which exclude local/poorer producers (Ribot, 1995; Baumert et al. 2016). But too often, such research underplays the function of charcoal within the household's livelihood strategy. Thus their conclusions drawn are only applicable to specialised producers, or those willing to specialise.

This could be problematic in two ways. Firstly, the majority of producers I spoke to over the course of this research would rather not become specialised producers (e.g. CA-6; CA-7). Taken alone, this contributes to a narrative of "last resort", but it actually mirrors more general trends. As Hall (2009) and Murray Li (2009) observe, the literature on "deagrarianisation" shows that many rural people often wish to move beyond agrarian lifestyles (Bryceson 1996). The important point though, is that for the poorest, moving away from the farm is not usually on advantageous terms (Murray Li 2009). Thus livelihoods such as charcoal production can persist, despite increasing opportunities, not out of a desire to conserve an agrarian lifestyle, but as a back-stop economic strategy, one that can provide security or refuge from a fluctuating formal economy. This brings me to the second issue. Where charcoal producers are economically marginalised, an increasing professionalization of their livelihood and move away from diversified strategies will likely be precarious. The link between formal and professional within charcoal markets narrows the forms of charcoal production that the state considers legitimate. This reduces the flexibility of charcoal as a livelihood, arguably its most important characteristic (Chapter two). Enforcing formal production criteria could therefore lead to producers having to find alternative, flexible forms of income. Amongst the producers spoken to in this research, almost all underscored how difficult it would be to replace charcoal as an income source. Charcoal production can be seen as a function of a lack of alternative opportunities for income (Zulu & Richardson 2013; Arnold et al. 2006), but here I wish to emphasise the lack of comparable opportunities, that can take such a flexible livelihood role.

1.2 The power of the informal

Overall, the results call into question the suitability of the formal governance of charcoal production as an environmental issue. This environmental governance acts to exclude small producers by de-legitimising their forms of production through the top-down imposition of forest management norms. In chapter four, I argue this produces an inherent bias towards specialised and professional forms of production.

In forestry, agriculture and mining - all sectors dominated by informality - development strategies tend to privilege large scale and export orientated businesses (Pokorny et al. 2013). This filters through into formal institutions. The stories are familiar across the informal resource sectors: In mining (Spiegel 2012), timber (Pacheco et al. 2008) and the broader forestry sector (Tieguhong & Schure 2015; Macqueen et al. 2015), legislative requirements are not sensitive to small-scale, small farm or family producers. Centralized visions of productive and economically thriving resource sectors, come face to face with the reality of diversified livelihoods, and fall short. By way of example, programs encouraging small businesses to formalise in South Africa, argues Ferguson (2007), were doomed from the start due to attempts to overlay an ordered vision of planning on messy and evolving urban areas. Remotely designed development "blueprints" laid out across messy landscapes are rarely workable, or equitable (Roe 1991).

The findings of this thesis suggest, in short, that formal institutions lack the capability to deal with the heterogeneous nature of small producers' livelihoods. Like other informal resource sectors, the visions of future charcoal markets reported in this thesis privilege larger-scale, heterogeneous and more organised forms of production (Chapter four). The implications of this link for small producers is wide-ranging. Certain roles that charcoal takes within rural livelihoods lend themselves to formalisation better than others. Where charcoal functions as a safety-net, commercialisation and formalisation is unlikely to benefit small-scale occasional producers as it is simply an extra financial burden.

It is not good enough for charcoal production to be theoretically legal, it needs to be literally accessible. But it is not simply the case that making formalisation easier will help small producers. The regulation as written concentrates primarily on the enforcement of

sustainable management practices. This requires oversight, order and planning, which is very hard to co-ordinate in a diffuse manner for many smallholders. Yet this misunderstands the role of charcoal within small producer's livelihoods. The flexibility, income immediacy and occasional nature of production are all vital - this lies at odds with forest management goals as they are currently outlined in many African states. Where small-producers produce charcoal for diverse reasons or link their agriculture and charcoal through their land-management practices, their production will struggle to gain formal legitimacy.

1.3 Scales of governance

A thread picked up on throughout the empirical chapters is the scales and modes of charcoal governance. Regulation can (re-)structure the competing claims for resource access. Therefore, where formalisation entails changes in regulation the ability of actors to benefit from the market shifts. This can work in a variety of ways. In Mozambique, small scale producers are excluded from the market (Chapter four), whilst specialised producers benefit (Baumert et al. 2016). More broadly, changes in scale of governance can preference actors with the ability to appeal to institutions operating at a variety of scales (Cleaver 2000), whereas centralisation in charcoal markets can preference urban traders (Poteete & Ribot 2011).

Arguments over governance scale are important in discussing informal markets and formalisation agendas (Spiegel 2012). In particular, the conflict between decentralisation on paper and decentralisation in practice is one picked up on within the charcoal literature. Effective decentralisation is more than implementing imposed agendas at a local scale, it requires representative authorities to be able to exercise discretion to govern resources meaningfully for local users (Ribot 2004). This is a thread touched on throughout the empirical chapters. The following three examples are indicative:

Firstly, the actions of the local district agricultural department outlined in chapters one and three in applying a de-facto licensing scheme showcase that allowing discretion in local governance can engender more flexibility. Secondly, the interpretation and subverting of information by the local chief in chapter three (aligning various sources of

knowledge about conservation agriculture, forest management, charcoal and rural livelihoods) to produce an outcome that "makes sense" is indicative of this process. Thirdly, in chapter four we see incipient attempts to govern resource use locally by the DDAs in Gaza being contested and undermined by provincial agricultural departments.

None of these examples are provisioned for within Mozambique's charcoal regulation. Without guidance or capacity, the DDA is currently legitimizing the production of charcoal in the face of national legislation, but still doing little more than simply capturing rent. Without the support of the forest law, the chief's actions are solely his compromise between unfeasible legislation and local pressures, as well as his attempt to legitimise his authority to govern the woodlands. These struggles between levels of governance (national regulation, provincial forestry departments, local agricultural departments and traditional authorities), reinforce the idea that contested resource rights are as much about authority as they are about access (Sikor & Lund 2009).

In Mozambique, despite efforts to foster the local governance of forests, the process is partial and incomplete (Sitoe et al. 2012). If formalisation of NTFP markets is to work, argues Wynberg et al. (2015), initiatives need to draw on local experience. Forest products are best regulated through customary or local authority, with state regulation being a complementary layer on top of this (Ibid.). Furthermore, because the forms that charcoal production takes are highly variable, allowing local institutions discretion is important for fostering sustainable and equitable woodfuel markets (Chapter three; Chapter four; Ribot 1995; Bensel 2008). However, central governments have tended to obstruct the decentralisation of forest governance across sub-Saharan Africa (Ribot et al. 2006). In informal economies this can lead to benefits of formalisation becoming more unequal (Spiegel 2012). The examples given in this thesis are indicative of similar patterns elsewhere in Africa, where decentralisation has not transferred discretionary power to local levels (Ribot et al. 2010). Whilst elements of the monitoring of charcoal production are decentralised, the inflexible nature of the regulatory framework reduces the scope for local institutions to act (Chapter four). The rigidity of regulation relating to small-producers within informal markets is a prominent theme within the literature on artisanal small mining (Hilson & Banchirigah 2009; Tschakert 2009; Spiegel 2012). This thesis echoes

the conclusions of this literature.

As a final aside, a common theme within the literature on informal markets is how central states do not differentiate between informal and illicit livelihoods, labelling both 'illegal' (Cerutti & Tacconi 2008). A lack of regional differentiation is also observed within this case, where attempts to make charcoal production formal based on the modes of production dominant in southern Mozambique, have rendered some forms of production illicit in central Mozambique. These distinctions get quite complicated. For example, the illicit decision taken by the DDA to revert to the old licensing scheme by the DDA in the case study of Community A essentially renders even the livelihoods of those licensed illegal, yet legitimises them in the eyes of the local governing authority. These sorts of complexities lead Cavanagh et al. (2015) to argue for more subtle approaches to the distinctions between formal-informal and legal-illegal livelihoods in the context of charcoal governance.

1.4 Implications for engaging with charcoal

In this section, the reflections offered for policy and practice relating to charcoal take two forms. The first set of reflections cover specific reflections on concrete issues within the context of Mozambique's governance of charcoal. The majority of specific recommendations however are contained within the appropriate chapters. The second set covers more general ideas about engaging with charcoal markets. These are supplemented in section two, which engages with future areas for charcoal research and therefore inevitably also relates in part to practice.

1.4.1 *Specific reflections on Mozambican charcoal policy*

The forest law as it currently stands is unsuitable for engaging with small producers (Chapter four). Firstly, it does not treat charcoal as a unique product, instead applying sustainable management techniques designed for the commercial production of timber to a different, complex and more socially embedded market. Secondly, it privileges ordered visions of planned rural energy production at odds with a complicated reality[2].

[2] Ferguson (2007), speaking about urban development states: "modernist urban planning sought to establish ordered, gridlike spaces of hygiene and political order, it inevitably encountered actual urban realities". Spiegel (2012) argues this practice is also inherent within the governance of Zimbabwe's mining

Thirdly, by focusing on criteria for sustainable forest management, the regulations frame charcoal primarily as an environmental problem and not as a rural livelihood.

These factors (see also chapter four) mean that the formal licensing of charcoal is currently unlikely to engage small producers. Nevertheless, I provide a few recommendations for making Mozambican forestry licensing more sensitive to charcoal and differing forms of production, before moving on to talk more generally about engaging small producers in section 1.4.2.

Firstly, and somewhat obviously, approaches to charcoal markets in Mozambique would benefit from being specifically tailored to the charcoal. As with elsewhere in Africa, charcoal governance seems to be shaped by higher level priorities (Cline-Cole & Maconachie 2016), in Mozambique's case environmental concerns and timber. Generally, this means taking a cautious attitude to aligning woodfuels and climate mitigation goals which run the risk of continuing to enshrine abstract environmental priorities through top-down changes to licensing regulation. More practically, plans to revise the simple license (due in late 2016), should look to specifically tailor rules to charcoal, rather than basing them on industrial models of timber production.

As seen in Community A, the high degree of informality currently allowed/tolerated and the relaxation of licensing requirements by the local district authority has enabled small producers to participate. But the propensity of the Mozambican state to suddenly decide on a greater degree of enforcement makes the livelihoods of those relying on charcoal precarious. Changes to charcoal regulation need to be phased in and well communicated, not suddenly enacted without warning and be developed based on existing forest management practices and (informal) institutional processes.

Enabling associations to meet forest management criteria through building their capacity and offering them incentives to form could provide a route for a wider range of producers to engage with informal production. However the extent to which associations can accommodate non-specialised producers remains unclear. Given the benefits of informality, it seems likely that regardless of the approach to the new forestry license, a

sector. Their research inspires this particular framing of chapter four's conclusions.

high degree of informality will remain. Thus, given the relationship between informal and formal producers outlined in chapter four, incentivising compliance for larger formal producers might be one route to better monitoring their practices. In Nepal for example, licensing for woodfuels currently includes incentives for charcoal briquette production and has been fairly successful in encouraging uptake of this new form of production (Benson et al. 2014). Yet care needs to be taken that incentives are well targeted, encouraging practices that are beneficial for a large number of people in the woodfuel value chain (see also section 2.1), as well as not removing routes to market for small producers.

Ultimately however it is reconceptualising the informal charcoal market as one of Mozambique's most important sources of livelihoods that will best foster change. Only then will approaches to the market begin to account for the flexibility and importance of informality. By putting livelihoods first, this opens the way for more sensitive approaches to informality. The de-criminalisation of charcoal livelihoods for small scale actors is one important step (Smith et al. 2015), though careful attention is needed to make sure that such initiatives are sensitive to the nuances of production practices. Small producers producing as part of field clearance (Chapter two), are not the same as the small producers making charcoal from branches in pits (Butz 2013), or specialised small producers working to supply major urban areas (Levy & Kaufman 2014).

1.4.2 *General reflections on approaches to charcoal and informal markets*

By unpacking an essentialist view of charcoal production as a specialised "livelihood of last resort", my aim in this thesis is to inform approaches that account for the heterogeneity amongst charcoal producers. The linking of environmental sustainability to rural development can't only be through the prism of specialising, professionalising and formalising livelihoods. Throughout the thesis, I have shown that the ability of small-scale charcoal producers to make a living from charcoal is facilitated by informality. I have documented the ways in which the informal market enables access and the formal market excludes. An increasingly vocal body of literature working in sectors as diverse as artisanal small mining and urban planning are arguing for approaches that willingly maintain, or actively encourage informality (Spiegel 2012; Tschakert 2009; Ferguson 2007; Putzel et

al. 2015). Chapter four concludes along similar lines, arguing for approaches to sustainability that engage with the informal sector.

Interventions need to be flexible enough to allow for a diversity of production situations. Interventions predicated on specialised models of production can act to exclude producers for whom charcoal takes a different livelihood role. This can simply lead to producers trying to find income elsewhere. For example, movement from one informal livelihood to another has been observed following regulatory changes and increased enforcement prioritising more organised forms of mining in Zimbabwe (Spiegel 2012). In other cases, miners have switched to more unsustainable and clandestine practices, to avoid law enforcement agencies (Ibid.). Therefore, I join other observers of informal markets in stating that it is unlikely greater enforcement of existing regulations is going to facilitate sustainable production (Spiegel 2012; Hilson & Banchirigah 2009; Hirons 2011). This is in sharp contrast to the literature on charcoal itself (Neufeldt et al. 2015; Njenga et al. 2013; Cerutti et al. 2015).

This synthesis and chapter four, also highlight a disconnect between the top down promotion of norms (in this thesis relating to forest management and forms of charcoal production) and the adoption of practices that align with these norms. This gap is well recognized (see, for example, the literature on the Millennium Development Goals (Fukuda-Parr & Hulme 2011)) – though continues to be problematic. Exploring this issue, Dawson et al. (2016) appraise 'green revolution' policies in sub-Saharan Africa by highlighting the difference between imposed and induced innovation and its effect on smallholder practices. The former, echoing the dynamics of the charcoal market, are dominated by centrally designated sustainability practices, propagated through formal institutions; whereas the latter look to the communities involved to provide innovations and instead work to provide a suitable environment for fostering such innovation. The novelty of engaging with informal markets to foster sustainability means that examples are few and far between. However, the following contrasting examples hint at the potential: In Egypt, transferring elements of the informal waste collection sector to private contractors has led to a drop in collection rates (GTZ 2010). Whereas in Vietnam and Brazil, providing legal recognition and micro-credit to informal waste collectors has led

to changes in practices that have improved the finances and safety of small producers (Benson et al. 2014). The results of this thesis suggest approaches that aim to induce/foster innovation amongst informal charcoal producers (and along the charcoal value chain), rather than impose top down sustainability criteria, may be promising.

Finally, the links between livelihoods and need for local discretion in governance suggest that currently fashionable calls for cross sector "landscape" approaches may offer some scope for addressing charcoal markets. Landscape approaches aim to manage complex landscapes in an integrated and holistic fashion, by incorporating the different land-uses into one management process (Sayer et al. 2013). Local resource users are an essential part of this process and thus efforts should be made to increase their capacity to manage their multifunctional landscapes (Ibid.). In diversified rural economies characterised by livelihood flux and informal markets, such approaches could offer routes towards flexible local governance and woodfuel planning. By moving beyond assessing sustainability at the level of production, a landscape approach could accommodate the linked agricultural and charcoal producing practices as demonstrated within chapter three.

2 Reflections on analytical approach and future research needs

Over the final few pages of the thesis I reflect on my analytical approach, highlighting some of the issues raised and their consequences for future research. I start by outlining an observation that has fallen between the gaps of the empirical chapters, but which I feel is important for future engagement with charcoal markets. This is the seemingly apolitical nature of calls for modernisation within the biomass energy sector. I then move on to discuss my analytical focus on rural livelihoods as well as the approach to forest loss taken in chapter three and provide suggestions for future research based on these insights. To conclude, I provide a brief reflection of the methodological approach.

2.1 Formalisation and a "modern biomass energy sector"

There is much to be applauded about the new generation of woodfuel studies that have seemingly contributed towards a shift in the narrative around biomass energy in Africa. This said, such applause drowns out discussion of significant differences of opinion and approach. In this section, I outline my concern that those calling for modernisation

within the literature on charcoal do not adequately engage with the political implications of modernisation.

The modernisation narratives that dominated discussions of woodfuel energy in the past, have not gone away (Cline-Cole 2007). They have simply morphed. Where once calls for alternative fuels dominated, today calls are for REDD+ compatible charcoal value chains (Schure, Dkamela, et al. 2014), industrial production through improved kiln technologies (Everest Energy 2013) and electrical co-generation (Ghilardi et al. 2013). Professionalisation and formalisation, critiqued in chapter four are also commonly linked to modernisation. All these offer promise for a "modern biomass energy sector" (Owen et al. 2013; Bailis et al. 2013).

This narrative emphasizing a transition from a "traditional" to "modern" biomass energy sector is increasingly central to discussions on the future of charcoal in sub-Saharan Africa. Cline-Cole (2007) views these attempts to re-frame woodfuels as the energy of the future as firmly anchored in exploiting neo-liberal opportunities to market new technology and innovations, rather than any desire for equitable markets. This approach has a variety of inflections, from the new opportunities for cookstoves, briquettes, high efficiency conversion and the incorporation of woodfuels into the production strategies of forestry companies (see for example: Everest Energy 2013; Portucel 2014). Outside charcoal markets, but heavily leaning on tropes about their negative nature, biofuel companies speak of opportunities to displace charcoal in order to tap into a $10 billion annual consumer spend (G-30).

I have several overlapping concerns about this emphasis. A key difficulty is that by being packaged as a classic ecological modernisation "win-win" a variety of linked schemes become dependent on the narrative of woodfuel's importance in forest loss. For example, speaking at a recent forum on clean cookstoves, climate scientists were ambivalent about their own results showing the vastly lower than assumed impact of woodfuels on the environment, because that means carbon offset funded cookstove interventions are less financially viable (SEI 2015). My primary concern however is that there is a real danger that narratives promoting a modern biomass energy sector and its associated technological fixes, will fail to fully interrogate their social and political impacts.

There is precedent here. The tendency of technology to "render complex systems controllable and difficult problems tractable" within agrarian development (Nally 2016, pg. 6) can also be seen within woodfuel interventions. Such a mindset has led to, for example, the bizarre claim that clean cookstoves can "stop" violence against women in conflict zones (Abdelnour & Saeed 2014). This is a somewhat extreme example. But it is perhaps indicative of the way that a technological imperative or "engineering bias" (Faber 2011, c.f. Nally 2016) gets in the way of sustained engagement with complex issues. A modern biomass energy sector faces "hurdles", "constraints" and "barriers", though such constraints often seem to be the current market, the producers and their livelihoods.

More insidiously, formalisation policies through environmental means provide opportunities for the management and control of forest resources by other market actors. Interviews conducted during the course of this thesis with forestry and energy companies suggested that a precursor to their involvement was to "level the playing-field" so that they could participate (G-28; G-29; G-30). As a clue to what an approach might look like, the African Development Bank is currently arguing for point of sale taxation of charcoal to enable the formal sector to compete within and against woodfuel markets (AfDB 2015). This would ensure price rises for urban users – a goal that is surely antithetical to most notions of pro-poor development.

These are not the only concerns with a "modern", large scale model of charcoal production based on forestry plantations. By way of example: In Namibia formalised, FSC certified forestry companies, using high tech production facilities continue to be supplied by informal woodfuel chains, but bring few livelihood benefits and supress producers' earnings, as smaller producers cannot compete (FERN 2015). In light of these experiences, the emphasis within Mozambique's strategy for reforestation on plantations for bioenergy, primarily operated by private companies (República do Moçambique 2009) is concerning. Such models of production are likely to create vastly fewer employment opportunities than informal production[3] and forestry plantations have had limited financial success in Mozambique over the past four decades (Hanlon & Smart

[3] Forestry plantation across Mozambique have been criticised for their inability to provide stable, well-paid work for significant numbers of rural residents (Seufert 2012).

2014). The legitimacy of large private sector interests to participate within the woodfuel sector comes from an outdated understanding of the woodfuel market that is founded on concerns about energy security, a perception of backwardness and above all, forest loss. This leaves little room for considering rural livelihoods.

As outlined in chapter four and earlier sections of this discussion, the link between formalisation, professionalisation and modernisation needs to be broken. The charcoal market's importance is entangled with the heterogeneity it offers rural people. By focusing on specialised livelihoods and modern visions of biomass energy in Africa, structural barriers are created to the participation of the market that can't be overcome in simple ways. Formalisation means trade-offs. The sustainable management goals for charcoal markets mean compromises. Making such trade-offs explicit and negotiable for all the actors involved is the first step towards equitable natural resource management (McShane et al. 2011).

I therefore think that there is a certain intellectual disingenuity about arguments for a modernised and formalised woodfuel sector. Continued used of tropes and narrative devices such as "powerful urban elites" and "vested interests" when talking about the informal sector, mask that the formalisation agenda is equally as problematic. Whilst well-connected urban interests do play a part within the large scale production of charcoal in large city markets (Ribot 1993), it is highly unlikely that any route to formalisation is going to automatically shift the power balance in favour of marginalised producers. Whilst there is currently a perceived need to formalise producer's rights and responsibilities to stop the undermining of improved technologies (Macqueen & Korhaliller 2011), such an approach needs to be mindful of which sorts of producer stand to benefit. In short, any given technology is only as strong as the "political, social and economic forces that promote them" and "will only serve the needs of people if they are designed and supported as part of a wider campaign of human rights and social justice" (Nally 2016, pg. 24).

2.2 Future research and reflections on analytical approach

In light of the discussion within the previous section, my first recommendation is that

contemporary research on charcoal needs to become more mindful of its political implications. Generally the literature on informal markets has a tendency to treat regulation as an "unproblematic tool for solving an obvious social ill" (Spiegel 2012, pg. 8). Research on charcoal markets is no exception. I therefore join Schure (2014) in calling for more research engaging with formalisation and the governance of woodfuels. A rich vein of research on other informal sectors, in particular artisanal small mining, could offer new approaches for research on woodfuels. Potential topics of interest may relate to the ongoing difficulties with formalisation, links between formal and informal production, the implications of re-framing of woodfuels as a "modern" energy source and the linking of woodfuels to programs such as REDD+ (see for example: Hofstad et al. 2009; Neufeldt et al. 2015).

Furthermore, in line with Smith (2016), I agree that more emphasis on charcoal markets from small and medium sized urban areas is important. This is not only due to their role in growing demand (Girard 2002), but to provide alternative perspectives on woodfuel markets in order to help contextualise future interventions. The need for alternative understandings and the highlighting of different experiences relating to the production of woodfuel (Cline-Cole 2007) is still pressing. One element of this could be to build on the findings of this thesis and emphasise charcoal's close links with other rural livelihoods. There is a lack of research on the "interlinkages between rural resource sectors" (Spiegel 2012, pg. 29) and how (informal) livelihoods are situated in heterogeneous, diversified livelihoods. Understanding these relations could allow for more nuanced approaches to governing small producers' use of natural resources.

With these general observations in mind, I now move on to look at elements of my analytical approach. I document some of the gaps left and the questions opened by the approach taken within this thesis across two areas: charcoal and rural livelihoods, and forest loss.

2.2.1 *Charcoal and rural livelihoods*

This thesis has strongly emphasized the ingenuity and diversity of rural charcoal producers and their livelihoods. However, in focussing on the ways in which charcoal is used within rural livelihoods, I have risked privileging detail and complexity over broader

patterns of political struggle and historical change (see: O'Laughlin 2001 for an overview on these debates within agriculture). To offer a concrete example: Cavanagh et al. (2015) characterise charcoal as a "livelihood of last resort", a framing I question in chapter two. But their characterisation is ultimately used warn against approaches to charcoal markets that further marginalise poor producers[4]. The focus on heterogeneity within this thesis does not aim to undermine such analyses, but to instead highlight a different set of dangers that result from a simplified story.

The results strongly support calls for more context within woodfuel planning and policy (Cline-Cole & Maconachie 2016; Cline-Cole 2007). One way to achieve this is by telling the stories of local, alternative woodfuel realities that lie outwith the generalised depictions of woodfuels dominant in popular, policy and academic discourse through further case studies such as this one. This thesis can therefore be seen to contribute to a strong tradition of "de-narrativisation" of prevailing views on woodfuels and smallholder agriculture in Africa (Dewees 1989; Fairhead & Leach 1995; Ribot 1999). Such analyses add complexity to an overly simplified view, rather than replacing them with an alternative compelling narrative (Roe 1991). But as new narratives aligning woodfuels, sustainable development and modernisation gain traction (Cline-Cole 2007), it is important that this complexity does not mask broader patterns of agrarian change. The story of the "multiplicity and variation" in the livelihoods of rural Mozambicans needs chapters on broader patterns of historical struggle and proletarianisation as much as it needs chapters about smallholder's ingenuity in the face of constrains (O'Laughlin 2001). Thus, understanding charcoal production in Mozambique (and elsewhere) could benefit from more historical and broad pattern based analysis – What is it about charcoal production that makes it such a contested livelihood? How do we situate booming informal livelihoods such as charcoal production and artisanal small mining in broader debates about the politics of agrarian change?

2.2.2 *Forest loss*

Whilst there are acknowledgements of differing forms of production in the literature

[4] In this particular case approaches built on historically close links between conservation and militarisation that are being expressed in new ways through current environmental narratives (Ibid.).

(Kambewa et al. 2007; Zulu & Richardson 2013), these have been obscured by a pervasive focus on a general depiction of charcoal's environmental impact. A side-effect of this is that the differing forms of production and their differential environmental impacts have not been interrogated (Chapter three). Therefore, a key conclusion that can be drawn from chapters two and three is that there is a need for different understandings of charcoal's links to forest loss. The role charcoal takes within livelihoods and its link to other household land-uses, in particular agriculture, makes it more difficult to understand charcoal's impact on forest loss without considering the household's activities as a whole. In chapter three, I argue this poses a problem for the ways in which we currently understand causality within forest loss, by parsing proximate causes into distinct land-use activities.

In this thesis I have been less interested in aetiology, focusing on the "how" and not the "why" of charcoal related forest loss. This has enabled important insights. Therefore, whilst I have not linked charcoal production specifically with forest outcomes I can suggest that focusing on the interaction between livelihoods will enrich research on the proximate causes of deforestation.

Whilst I use the term "proximate causes of deforestation", in line with Geist and Lambin's (2002) framework presented in chapter two, I am concerned about how the reductionist approach of the framework impacts our engagement with forest loss in complex environments. In a study on REDD+ policy documents in Zambia, Holmgren (2013) argues that the driver's framework puts the focus on a homogenous actor "local forest dependent communities" who become the key site of action for addressing proximate drivers. Despite acknowledging specific proximate causes, structural processes are ignored as there is ultimately no accountable actor who can act as a focus for interventions. Theoretically, a proximate-distal divide promotes the analysis of specific events out with their political economic context and yet simultaneously argues that focus on the specifics is futile as long as "fundamental" forces are in play (Krieger 2008).

The critique of distinct proximate drivers outlined within chapter three should therefore be read alongside others that address the simplistic view of deforestation and over-riding focus on local drivers that the separation of drivers into proximate and underlying

produces (Kamelarczyk & Smith-Hall 2014). Whilst research on charcoal markets has been savvy to the importance of broader market function for understanding deforestation patterns (Leach & Mearns 1988), there has been considerable difficulty linking broader approaches to markets with livelihoods and forest outcomes. Attempts to link value chain analysis, the sustainable livelihood framework and forest outcomes have tried to bridge this gap (Schure 2014). Yet research into forest loss within charcoal markets still tends to oversimplify the social nature of forest loss (see for example: Mwampamba 2007; Ahrends et al. 2010), whereas research into the social aspects of charcoal markets still does little to dispel the notion that "ecological blindness is a congenital defect of sociologists" (Beck 1995, pg. 45).

Policy makers and NGOs, forestry companies and consultancies continue to be drawn to the drivers approach precisely because of its simplicity[5]. A fruitful area for future research could further consider the impact that this has on our understanding of deforestation as well as the ways in which it informs conceptualisations of forest loss within interventions, policy approaches and international initiatives such as REDD+. What is particularly concerning is that preliminary studies along this theme suggest that our understandings of forest loss mainly reproduce old prejudices, outlined by a narrow band of experts, re-circulated and given authority by their re-production in policy briefs, technical documents (Kamelarczyk & Smith-Hall 2014) and scientific publications (see: Hosonuma et al. 2012; Kissinger et al. 2012).

Finally, whilst I have espoused the benefits of a livelihoods approach to forest loss, this has meant the side-lining of ecological perspectives on the woodlands that these cases have come from. I see this as an inevitable compromise in the short time-span of a PhD. The results of this thesis could feed in well to future research aiming to combine perspectives however. In particular, there is an urgent need for more research on the sustainable management of miombo woodlands, to (hopefully) counter the idea that large-scale Eucalyptus plantations are the only viable means to achieve woodfuel sustainability. Whilst the technical elements of this are fairly well covered (Chidumayo 1988; Lupala et

[5] It forms the basis of the REDD+ literature and associated interventions across the miombo eco-region for example (LTSi 2015).

al. 2014), their application within charcoal markets is rare, reducing the opportunity for empirical research.

2.3 Reflections on my methodological approach

A number of recent studies on woodfuels are adopting mixed method approaches to woodfuel markets (Smith 2016; Schure 2014). This thesis adds to this trend, echoing the positive conclusions about the ability of such an approach to improve internal validity through triangulation, navigate the gap between practically applicable research and academic research, and provide novel perspectives on woodfuel issues. Yet like these authors, a number of challenges were also encountered:

- Firstly, this study represents the first study of woodfuel in Manica province. This meant data had to be collected without a baseline. Furthermore, studies in southern Mozambique have focused primarily on the value chains, rather than the producers leaving little comparable Mozambican data.

- Secondly, the scale of research was substantially constrained by the nature of a time-intensive mixed methods approach. Thus to some degree, this thesis has sacrificed breadth for depth. This conscious choice does in places partly impact the generalisability of the findings due to a narrow geographic and small-town focus.

- Thirdly, the informal nature of charcoal production means that building trust is vital to producing in-depth and reliable data about an occasionally precarious livelihood. Whilst the use of ethnography at the start of the fieldwork, with its inductive leanings and slow approach to building community relations was invaluable, this remains a time-intensive luxury afforded by the PhD process. Research on informality presents considerable challenges in this regard, ones not fully explored within the literature on charcoal production

A final recommendation is that research on charcoal production would benefit immeasurably from longitudinal research. Whilst this is beyond what can be achieved within the time-frame of a PhD, such research would provide insights into forest loss and

livelihood flux relating to charcoal market development.

3 Conclusion

In this thesis, I set out to investigate the role of charcoal in the livelihoods of small-producers. In doing so I have looked at how informality (and formalisation) shapes their outcomes and how their practices complicate simplified notions of forest loss. The picture of small-scale charcoal production that emerges from the thesis is one of a flexible cash-income generating strategy, complicated by the politics of forest loss and livelihoods at local and national levels. This diversity however is not addressed by current approaches to charcoal in Mozambique, which exclude small-producers.

As academics and policy makers begin to (inadvertently) respond to Harcharik's (1995) appeal to rethink the narrative that links woodfuels to poverty and underdevelopment, it is important that the reframing of the woodfuel debate takes livelihoods and not the environment as its starting point. In agreement with an incipient "livelihoods turn" in the literature on charcoal, I agree that charcoal production should be seen as an opportunity to support rural development. But alongside a substantial body of work in NTFP studies, this thesis confirms the challenges in combining environmental and developmental objectives through forest product markets (Belcher & Schreckenberg 2007; Ros-Tonen & Wiersum 2005; Arnold & Perez 2001). Whilst such a conclusion has long been at the forefront of debates on woodfuels, it is important that a re-framing of charcoal as a sustainable development opportunity does not lose sight of this wisdom. Throughout this thesis I have shown how acute this challenge is for smaller producers, particularly when the regulatory framework within which they operate is predicated on a mode of production antithetical to theirs.

Charcoal plays a vital role in rural economies, not only in spite of its informality, but because of it. Whether the formalisation and modernisation of charcoal markets can engage small producers is doubtful. The diverse outcomes of woodfuel markets are inevitably going to require contextual, nuanced and locally relevant solutions. Thus there is a need for new approaches to charcoal and other informal economies, ones that are attuned to the diversity of livelihood practices, aware of the problems associated with the

top-down imposition of norms and wary of visions of a large-scale, efficient, ordered and formal resource sector. The rigidity of environmentally focused legislation excludes small-producers. Thus in order to allow charcoal livelihoods to flourish and to improve sustainability, interventions need to work with, and for, charcoal as an informal livelihood. To do this, we need to give producers a louder voice in the governance of woodfuels. By not doing so, current approaches to charcoal that link environmental goals and market formalisation risk subjugating rural producers through attempts to do them good.

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Appendices

Appendix A

Interview reference tables

CG-##

Table 7 – Interviews conducted within Community A

Code	Charcoal producing	Gender	Location	Type	Language	Date
CA-1	Yes	M	Community A	Interview	chiManyika/local	Autumn 2013
CA-2	No	M	Community A	Interview	chiManyika/local	Autumn 2013
CA-3	Yes	F	Community A	Interview	chiManyika/local	Autumn 2013
CA-4	No	M	Community A	Interview	chiManyika/local	Autumn 2013
CA-5	Yes	M	Community A	Follow up interview	Portuguese	July 2014
CA-6	Yes	M	Community A	Follow up interview	chiManyika/local	July 2014
CA-7	Yes	Group	Community A	Follow up interview	chiManyika/local	July 2014
CA-8	Yes	F	Community A	Interview	chiManyika/local	Autumn 2013
CA-9	Yes	F	Community A	Interview, mapping	chiManyika/local	Autumn 2013
CA-10	No	M	Community A	Interview, mapping	English	Autumn 2013
CA-11	No	M & F	Community A	Follow up interview	chiManyika/local	July 2014
CA-12	No	M	Community A	Interview	chiManyika/local	Autumn 2013
CA-13	Yes	M	Community A	Interview	chiManyika/local	Autumn 2013
CA-14	No	F & M	Community A	Interview	chiManyika/local	Autumn 2013
CA-15	No	F	Community A	Interview, mapping	chiManyika/local	Autumn 2013
CA-16	Yes	F	Community A	Interview	chiManyika/local	Autumn 2013
CA-17	Yes	M (2)	Community A	Interview	chiManyika/local	Autumn 2013
CA-18	No	F	Community A	Interview, mapping	chiManyika/local	Autumn 2013
CA-19	Yes	F	Community A	Interview	chiManyika/local	Autumn 2013
CA-21	Yes	M	Community A	Interview, mapping	chiManyika/local	Autumn 2013
CA-22	Yes	M	Community A	Interview	Portuguese	Autumn 2013
CA-23	Yes	F	Community A	Interview	chiManyika/local	Autumn 2013
CA-24	Yes	M	Community A	Interview, mapping	chiManyika/local	Autumn 2013
CA-25	No	M	Community A	Interview - narrative	chiManyika/local	Autumn 2013
CA-26	Others on her land	F	Community A	Interview - narrative	chiManyika/local	Autumn 2013
CA-27	No	M	Community A	Interview - narrative	chiManyika/local	Autumn 2013
CA-28	Yes	M	Community A	Interview, mapping	chiManyika/local	Autumn 2013

Code	Charcoal producing	Gender	Location	Type	Language	Date
CA-29	Yes	F	Community A	Interview	chiManyika/local	Autumn 2013
CA-30	Yes	M & F	Community A	Interview	chiManyika/local	Autumn 2013

CC-##

Table 8 – Commodity chain interviews

Code	Role	Gender	Location	Type	Conducted by	Language	Date
CC-1	Chapa driver	M	Town A	Interview	Daniel Jones	Portuguese	Autumn 2013
CC-2	Transporter	M	Town A	Interview	Daniel Jones	Portuguese	Autumn 2013
CC-3	Producer	M	Cruza-mento	Interview	Daniel Jones	chiManyika/lo-cal	July 2014
CC-4	Producer	F	Vanduzi	Interview	Fibian Manuel & Ajape	chiManyika/lo-cal	July 2014
CC-5	Producer	M	Vanduzi	Interview	Daisy	Portuguese	July 2014
CC-6	Trader	2 M	Chimoio	Interview	Teodora Bomba	Portuguese	July 2014
CC-7	Trader	3 M	Chimoio	Interview	Daniel Jones	Portuguese	July 2014
CC-8	Trader	M	Town A	Interview	Daniel Jones	Portuguese	May 2013
CC-9	Trader	1 M	Town B	Interview	Daniel Jones	Portuguese	July 2014
CC-10	Trader	2 M	Town C	Interview	Daniel Jones	Portuguese	July 2014
CC-11	Roadside traders	3 F, 12 M	Cruza-mento	Focus group	Daniel Jones & Clayton	Portuguese	July 2014
CC-12	Transporter	M	Town A	Interview	Daniel Jones	Portuguese	July 2014
CC-13	Trader	3 M	Town A	Interview	Daniel Jones	Portuguese	July 2014
CC-14	Producer	M	Ponto	Interview	Daniel Jones	ChiTewe	July 2014
CC-15	Producer	2 M	Ponto	Interview	Daniel Jones	ChiManyika	July 2014
CC-16	Trader	M	Chimoio	Interview	Daniel Jones & Jervasio Luis	Portuguese	July 2014

CG-##

Table 9 - Community level interviews conducted in, or relating to, the Secondary case study area. Only cited interviews included as the majority were not conducted by myself and therefore have had less of bearing on the content of this thesis.

Code	Role	Gender	Location	Type	Conducted by	Language	Date
CG-1	Charcoal Association	1 M	Secondary Case	Interview	Sophia Baumert	Portu-guese	June 2014
CG-2	Charcoal Association	2 M	Secondary Case	Interview	Sophia Baumert	Portu-guese	June 2014

Code	Role	Gender	Location	Type	Conducted by	Language	Date
CG-3	Charcoal Association	4 M, 1 W	Secondary Case	Interview	Sophia Baumert	Portuguese	June 2014
CG-4	Charcoal traders	3 M	Maputo	Interview	Daniel Jones	Portuguese	August 2014
CG-5	Charcoal producers	M	Secondary Case	Interview	Sophia Baumert	Portuguese	June 2014
CG-6	Community Forest Officer	M	Secondary Case	Interview	Sophia Baumert	Portuguese	June 2014
CG-7	Charcoal Association	7 M	Secondary Case	Focus Group	Sophia Baumert & Ana Luz	Portuguese	June 2014
CG-8	Roadside enforcement officer	M	Secondary Case	Focus Group	Sophia Baumert	Portuguese	June 2014
CG-9	Roadside enforcement officer	M	Secondary Case	Focus Group	Sophia Baumert	Portuguese	June 2014
CG-10	Roadside enforcement officer	M	Secondary Case	Focus Group	Sophia Baumert	Portuguese	June 2014

G-##

Table 10 – Governance and key-informant interviews.

Code	Organisation	Role	Location	Date
G-10	DDA	Director	Town A	June 2014, July 2014
G-11	DDA	Fiscal	Town A	June 2014
G-12	DDA	Extension officer	Town A	June 2014
G-13	SPFFB Chimoio	Director	Chimoio	June 2014, August 2015
G-14	DDA	Fiscal	Town B	July 2014
G-15	DDA	Fiscal	Town C	July 2014
G-18	Posto administrativo	Chefe de posto	Community B	July 2014
G-19	Posto administrativo	Chefe de posto	Community C	July 2014
G-20	SPFFB Chimoio	Fiscal	Chimoio	July 2014
G-22	SPFFB Xai-Xai	Fiscal	Xai-Xai (Telephone)	January 2016
G-23	SPFFB Xai-Xai	Director	Xai-Xai (Interview by Sophia Baumert)	Unknown 2015
G-25	Portucel	Forestry manager	Chimoio	August 2014
G-26	DNFFB	Forestry Officer	Maputo	August 2015
G-27	Gary Littlejohn	Academic	Maputo (Telephone)	October 2015
G-28	Green Resources	Country manager	Nampula	July 2013
G-29	Everest Energy	Director	Rotterdam (Telephone)	October 2015
G-30	Cleanstar Mozambique	Chief executive	Kampala (Telephone)	June 2015

Code	Organisation	Role	Location	Date
G-31	Greenlight Mozmabique	Director	Maputo	August 2015
G-32	SPFFB Chimoio	Fiscal	Cruzamento	July 2014
G-33	DPA	Agricultural researcher	Chimoio	April 2014

Appendix B

Templates for semi-structured interviews

The following questions formed a basic pool of prompts for semi-structured interviews for households who produced charcoal. This template was applied in both within the "ethnographic" period of fieldwork and the follow up interview stages. All interviews were tailored to respondents and phrasing will have varied depending on the language of the interview. Questions are organised by theme.

More "academic" icebreakers

If you could pick any crop to grow on your land, what would you grow?
For you, is agriculture a business?

General questions

Where are you from?
When did you come to this area for the first time?
    If you are not from this area, where did you stay just before coming here?
    What did you do there?
Do you stay here throughout the year?
    When are you here?

Livelihoods

How would you describe the livelihood opportunities here?
What do you do to "make a living"?
    Probe:
        What activities have you done this year that have made money?
        What activities have you done that helped you get (food/asset)?
        Have you helped out friends and family with a job? What did you get in return?
What "businesses" do you have?
    If agriculture:
        Which crops make money?
        Why?
        Why have you chosen x,y,z crop?
Go through livelihoods mentioned: How would you describe the difference between x and y?
If you need money quickly, what can you do?
Does anyone here pay people to help on their farm?
    Who? How would you describe them?
Are there any companies here that pay? (Have there been any companies here that pay?)
    What sort of work? What is it like? Have you participated?
Do you have any (formal) training as a (skilled) laborer?
    What training do you have?
    Have you ever been employed in a job that used your training?

What do you think about charcoal/mining/agriculture?
Have your ever tried….?
Would you like your children to be farmers/charcoal makers/miners?

Community

Do different areas of the community have different livelihoods?
If so, why?

How would you describe local support for RENAMO/MDM/FRELIMO?
Do different party supporters have different livelihoods?

Charcoal general

Why do you make charcoal?
How many years have you been making charcoal?
Where did you first learn to make charcoal?
Who taught you to make charcoal?
How would you describe their skill level?
Did you come to this area specifically to produce charcoal?
Is charcoal your only work?
Compared to your other work, how important is charcoal?
What makes it different?

Charcoal production

When do you make charcoal?
Times of year and circumstances.

What things do you need to make charcoal?
How did you choose the area to make charcoal? What are most important factors?
In charcoal making, what are the main steps from start to finish?
Who helps out and at which steps?
How do you divide work and profits among your partners?
Do you/How much do you pay workers/helpers? Describe the arrangements.
Which step is the hardest?

Do you leave trees behind when you make charcoal? Why/why not?
Which trees do you leave, why?
What are other uses of the trees in this area?
What use will this land be used for after you are finished making charcoal?
Will you plant crops on this land after you clear it?
Which crops? Why?
Does land cleared for charcoal make a good field? Why?
Is this different to "new" land?
Does this influence your crop choice?

How many bags of charcoal do you produce:

In a typical kiln?
What affects this?
This past month?
How does this month compare to a normal month?
(Roughly) How many bags of charcoal have you made in the past 12 months?

What are the characteristics of good charcoal?
Which kinds of tree make the best charcoal?
Why?
Do you have trouble finding the best tree species?
Which species are difficult to find?
Since when?
Do your buyers ever ask you for charcoal from specific trees?
Which kinds?
Name a tree that is NOT suitable for charcoal making and explain why.

Charcoal selling (questions for producers)

Who buys your charcoal?
Do you sell to the same person? Do you have a choice of buyers?
How would you describe the buyers?
How many bags do these buyers typically buy at one time?
When do you make the agreement to sell charcoal?
Before production or after production?
Do you sell it all at once?
Where does it go? Where do your customers sell the charcoal?
How do your customers usually transport the charcoal?
Do you change anything about the charcoal, based on its selling location?

At what price do you currently sell charcoal?
Is this price the same every month or does it go up and down?
During the past year, which months did you get good prices and which months did you get bad prices?
What is the best price per bag of charcoal that you have received over the past year?
When?
What is the worst?
When?
Who or what effects the price of charcoal?

Land ownership and land management questions:

How long have you been producing charcoal here?
Do you own the land where you make charcoal?
Did you seek permission to make charcoal on this land or did someone ask you?
From whom did you seek permission? Who approached you?
What's the arrangement?

What is the total size of the area?
What is the size that you can clear?

Have you ever had any problems with others wanting your land? Do you feel "safe" here?

Problems and solutions

Do you ever come across problems?
- From local authorities/neighbors/landowners/other producers?
- Environmental problems (weather etc…)

Have you ever had charcoal confiscated?
What is the most difficult thing about making charcoal?

If kiln being prepared:

Description
Dimensions
GPS location

Tree types, what remains standing. Check soil type. Compare with surrounding woodland if available. Have any trees been added from the surrounded area?

Governance

What do you think of the chief's attitude to charcoal?
What do you think of district agricultural department's attitude towards charcoal?

Appendix C

Questionnaire survey

The survey has been re-formatted and translated from Portuguese for inclusion in this thesis. There are thus some differences in phrasing and structure compared to the survey used during the field work

Introduction guide

- Introduction
- Types of questions
- Purpose
- This research is not linked to an NGO/government...
- Confidentiality
- Duration
- Questions?

Control Information

	Date	**By whom?**	**House Number**	**Language** *Code: 1=chiManyika; 2=chiShona; 2=Português; 3=other, specify*
Interview	*Date*		*FID*	*Code*
Verified	*Date*	*Name*		
Digitized	*Date*	*Name*		

A: Identification

1	Name of the primary interviewee	*Name*	
2	Name of the region	*Name*	
3	Names of the interviewees	*Name*	*Gender*
		Name	*Gender*
		Name	*Gender*
4	GPS reference point	36K _ _ _ _ _ E _ _ _ _ _ _ _ N *#*	
5	If you need salt, where do you buy it?	*Place name*	
6	How far is it? (in minutes walking and in kilometers)	*min*	*km*

B: Household composition

1	Number of people in the household*			#
2	Number of people in the household that work on the household's fields			#
3	Number of people in the household that go to school?			#
4	**Age**	**Men**	**Women**	**Total**
	0-4	#	#	#
	5-12	#	#	#
	13-20	#	#	#
	21-60	#	#	#
	>60	#	#	#

*We understand the household as being any persons **who eat from the same pot** as the interviewee or who help to feed the household, even if they do not live here, but that do not eat from another pot. Key phrase: **All individuals who normally live and eat their meals together in this household.**

C: The household

1	Who makes economic decisions in your household? * *Codes: 1=Only by the wives and/or adult female members of the household;* *2=Mainly by the wives and/or adult female members of the household;* *3=Both adult men and women participate equally;* *4=Mainly by the husband and/or adult male members of the household;* *5=Only the husband and/or adult male members of the household;*	*code*
2	What is the age/ages of [C1]?**	*years*
3	Did the household form in this area? *Codes: 1=yes; 0=no*	*(1-0)*
4	**If 'no':** How long has [C1] lived in this area?	*#s*
5	Before 1992 where did [C1] live? *Codes: 1=District A; 2=Mozambique (outside district A); 3=Zimbabwe; 4=Other; 5=N/A*	*codes*

* Use scenario example from focus group for definition of "economic decision".
** Use relationships defined by C1.

D: Livelihoods

1	What activities do you consider the most important to sustain your household?		Livelihood (specify)	Type of work* *Codes* *1= Self-employed* *2= Permeant contract* *3. Long term contract (year or more)* *4= Short term contract (less than a year)* *5= Casual work* *6=other, specify*	Is the work seasonal? *Codes* *1= yes;* *0=no*
		1	*Primary*	*code*	*(1-0)*
		2	*Secondary*	*code*	*(1-0)*
		3	*other*	*code*	*(1-0)*
		4	*other*	*code*	*(1-0)*
		5	*other*	*code*	*(1-0)*
2	Nos últimos 3 meses, que outro rendimento recebeu? *0=No;* *1=Sent money;* *2=Government, or NGO; *** *3=Donations or help from family/friends;* *4=Pension;* *5= Payment for renting of land or similar;* *6= other, specify*				*code*

* For agriculture more than one code may be needed. Probe for contract farming (tobacco in particular).
** Please note type of payment, if they willingly share the information.

E: Land

Plot *Codes:* *M=Machamba* *G=Garden or matorro*	**Principal crop**	**Variety** *Codes:* *1= bought; 2= own; 3= bought but re-used*	**Sold?** *Codes: 0= no; 1=yes; 2=sometimes*	**Secondary crop** *Codes: 0= no; 1=yes*	**Sold?** *Codes: 0= no; 1=yes*	**Area** *approx.*	**Tenure** *Codes:* *1. Owned by household* *2. Rented* *3. Borrowed* *4. Community land* *5. Owned by co-operative* *6. Owned by clan* *7. State land* *8. Other (specify___)*	**Years cultivated**	**How many more years of cultivation?** *Codes:* *1=one or two; 2=three or four; 3=more than four; 4=permanent*	**Rotation/management?**	**Soil type**	**Inputs** *Codes:* 0= None 1. bought seeds 2. Inorganic fertilizer 3. Organic fertilizer 4. Pest -/ herbicides 5. Irrigation water 6. other (specify___)
1		*c*	*(1-0)*	*c*	*c*	*ha*	*c*	*#*	*c*			*codes*
2		*c*	*(1-0)*	*c*	*c*	*ha*	*c*	*#*	*c*			*codes*
3		*c*	*(1-0)*	*c*	*c*	*ha*	*c*	*#*	*c*			*codes*
4		*c*	*(1-0)*	*c*	*c*	*ha*	*c*	*#*	*c*			*codes*
5		*c*	*(1-0)*	*c*	*c*	*ha*	*c*	*#*	*c*			*codes*
6		*c*	*(1-0)*	*c*	*c*	*ha*	*c*	*#*	*c*			*codes*
7		*c*	*(1-0)*	*c*	*c*	*ha*	*c*	*#*	*c*			*codes*
8		*c*	*(1-0)*	*c*	*c*	*ha*	*c*	*#*	*c*			*codes*
9		*c*	*(1-0)*	*c*	*c*	*ha*	*c*	*#*	*c*			*codes*
Your notes:												

F: Fallow

1	Does the household have any fields that they do not cultivate? *Codes: 1=yes; 0=no*			*(1-0)*		
2	Machamba	Area (approx.)	How many years has the machamba not been cultivated? *Codes: Number of years or 77=very old*	Reason for not cultivating *Codes: 1) reduction in household size 2) lack of money, 3) fallow, 4) lack of market for crop, 5) lack of rain, 6) lack of seeds, 7) other, specify*		
				Rank 1	**Rank 2**	**Rank 3**
	1	*ha*	*#*	*c*	*c*	*c*
	2	*ha*	*#*	*c*	*c*	*c*
	3	*ha*	*#*	*c*	*c*	*c*
	4	*ha*	*#*	*c*	*c*	*c*
	5	*ha*	*#*	*c*	*c*	*c*
	6	*ha*	*#*	*c*	*c*	*c*
3	Has the amount of land you cultivate changed over the past five years? In what way? *Codes: 1=increased; 2= stayed the same; 3= decreased*			*code*	*reason*	
4	Have your yields (primary two crops) altered over the past five years? In what way? *Codes: 1=increased; 2= stayed the same; 3= decreased*			*code*	*reason*	
5	Has the area devoted to cash crops changed during the last 5 years? In what way? *Codes: 1=increased; 2= stayed the same; 3= decreased*			*code*	*reason*	

G: Forests

1	What is the distance between your home and nearest forest (natural or managed) which you have access to and can use?	....measured in terms of distance (straight line estimate)	*km*
		… measured in terms of time (minutes walking)	*min*

H: New fields

1	What are your main motivations for opening a new field? *Codes: 1=need new soil; 2= need more food; 3= to sell; 4= change of residence; 5=increase in household size (members); 6= other, specify*			**1** *code*	**2** *code*	**3** *code*
2	For you, what are the most important considerations when opening new fields? *Codes:* 1*=good soil; 2=good trees for other uses; 3=proximity to another field (e.g. field extension); 4=ease of preparation; 5=water availability; 6=other, specify*			**1** *code*	**2** *code*	**3** *code*
3	Has the household cleared any land in the past 12 months? *Codes: 0=no; 1=yes* **Se no dirija-se para a Q14**			*(1-0)*		
4	**Se yes:**	Estimate of area cleared		*ha*		
5		Hired labour *Codes:* 0=no; 1=yes		*(1-0)*		
6		Why did you choose this area? *Codes:* 1*=good soil; 2=good trees for other uses; 3=proximity to another field (e.g. field extension); 4=ease of preparation; 5=water availability; 6=other, specify*		**1** *code*	**2** *code*	**3** *code*
7		What type of vegetation did you clear? *Codes: 1=an old field with trees; 2=an old field with mainly bushes and bamboo; 3=an old field with grass; 6=forest; 7=other, specify*		*code*		
8			**If 1-4:** How long has this land been fallow for?	*years*		
9		**If trees felled**: After clearing the land, what did you do with the trees? *Codes: 1= used them for firewood, 2= burnt them on the field, 3= used for timber, 4= made charcoal, 5= construction; 6= other, specify*		**1** *code*	**2** *code*	**3** *code*
10		What did you used the land for? *Codes: 1=crops; 2=planting trees; 3=pasture; 4=charcoal; 5=construction (i.e. new house) 6 = nothing; 7= other, specify*		**1** *code*	**2** *code*	**3** *code*
11			**If crops planted:** What was the main crop?	*Name of crop*		
12			If Maize**:** what sort? *Codes: 1=households; 2=Pan (specify type); 3= matuba; 4=Zimbabwean; 5=chiManyika*	*code*		
13			**If Maize**: Where did you get the seeds? *Codes: 1=reusded; 2=bought in a shop; 3=part of a contract; 4=Co-op; 5=NGO; 6= other, specify*	*code*		
14	Has the household cleared any forest over the past five years? *Codes: 0=no; 1=yes*		*1 last year*	2	3	4	5

H: Charcoal

1	Has anyone in the household produced charcoal over the past 12 months? **If no go to Q15**												*(1-0)*
2	If yes:	Which months	**2013** Jun	Jul	Aug	Set	Out	Nov	Dez	**2014** Jan	Fev	Mar	Abr	Mai
		What was the number of sacks produced?												*#*
		What was the tenure of land on which the charcoal was produced? *Codes: 1. Household's; 2. rented; 3. borrowed; 4.community land 5= Co-op; 6=Church; 7= State; 9=variable; 10=the land of a friend or family; 11= Other, specify*												*Code and details*
4		Which members of the household participated? *Codes: 1=Only the wives and/or adult female members of the family; 2=Mainly by the wives and/or adult female members of the family; 3=both adult men and women participate equally; 4=Only the husband and/or adult male members of the family; 5=Mainly by the husband and/or adult male members of the household; 7=None of the alternatives*												*Code and specify relationship (i.e. son, [C1] etc…)*
5		In what situations do you produce charcoal? *Codes: 1=as part of the preparation of a new field; 2=as a key livelihood for the household; 3=when the price of charcoal is high; 4= when the household needs money; 5= other, specify*	**1** *code*				**2** *code*					**3** *code*		
6		What species do you use?												*specify*
8		Why did you choose this area? *Codes: 1=prevalence of good species for charcoal production; 2=proximity to point of sale; 3=soil fertility; 4= size of the trees; 5=other, specify*	**1** *code*				**2** *code*					**3** *code*		

9		How did you fell the trees? *Codes: 1=all the trees in the area; 2=selective cutting; 3=a combination of 1 and 2; 4= other, specify*				*code*
10			If 1: What was the approx. area cleared?			*(ha)*
11		What was the cleared area used for? *Codes: 1=crops; 2=planting new trees; 3=pasture; 4 = nothing; 5=construction; 6= still forest; 7= other, specify*				*code*
12		Have you sold the charcoal?				*(1-0)*
13		If yes: What was the price of the last sack?				*meticais*
14		If yes: What did you use the money for? (specify specifics) *Codes: 1=improved seeds; 2=inputs; 3=labour;4=money for general; 5= agricultural equipment; 6= other, specify*	**1**	**2**	**3**	

15	In the past 5 years has anyone in your household produced charcoal?	*1 last year*	2	3	4	5
16	In the past 5 years has anyone from outside the household produced charcoal on the household's land? *Codes: 0= no; 1=yes*					*(1-0)*

17	Do you use charcoal?		*(1-0)*
18	If yes:	When? *Codes: 1= all year; 2=rainy season*	*code*
19		How many times have you used charcoal over the past 30 days?	*#*

1	Does the family collect wood? **If 'no', go to Q7.**				*(1-0)*
2	If yes:	If 'yes': How many times a week do family members collect firewood for household use?		*times*	*Average time*
3		What are your main sources of wood? Codes*: 1* = fallen branches*;* 2 = cut branches*;* 3 = specifically cut trees*;* 4 = trees felled primarily for other purposes*;* 5 = other, specify	**1** *code*	**2** *code*	**3** *code*
4		Does the household spend more or less time collecting wood compared to five years ago? *Codes: 1=more; 2=more or less the same; 3=less*			*Code and reason*
5		How has changed the availability of firewood changed over the last five years? *Codes: 1=decreased; 2=more or less the same; 3=increased*			*Code*
6		**If 1:** What do you think is the reason for this?			
7	Do you buy firewood?				*(1-0)*
8	Has the household planted any trees over the past five years? **If 'no', go to the next section.**				*(1-0)*
9	If yes: What was the main purpose of the trees planted? *codes: 1=firewood for own use; 2=firewood for selling; 3=Timber/construction for own use; 4=Timber/construction for selling; 5=fruit; 6=Land demarcation; 7=To increase the value of my land; 8=production of charcoal; 9= other, specify*		**1** *code*	**2** *code*	**3** *code*

House

1	What is the principal (most common) material for the household walls? *Codes: 1=mud/sand; 2=wood; 3=corrugated iron; 5=tijolos (local) 6=tiles or cement (not local); 6=bamboo (with mud); 7=other, specify:*	*code*	
2	What is the principal material (most common) for the household roof? *Codes: 1=grass; 2=Wood (plants); 3=corrugated iron; 4=tiles; 9=other, specify:*	*code*	
3	Number of divisions *(houses and divisions in the main house)*	*houses*	*divi-sions*

Services

1	Electricity Codes*: 1.* No electricity 2. Generator 3. Solar 4. Other, specify	*code*
2	Water source Codes: *1*=Public network 2=Well or protected borehole*;* 3=unprotected well (or river); 4=Other, specify	*code*
3	Sanitation *Codes:* *1. No toilet or latrine* *2. Flush toilet to a septic tank or sewer* *3. Private latrine with a slab or platform made from cement or wood, with a squatting hole or seat* *4. Private latrine without a slab or platform, just a mud floor with a hole in the ground* *5. Public/shared latrine* *6. Other (specify___)*	*code*

Life

1	Has your production of food and income in the last 12 months been sufficient to cover what you considers to be the households needs? *Codes: 1=yes; 2=reasonable (just sufficient); 3=no*	*code*
2	Compared to other households locally, how would you describe your situation? *Codes: 1=more prosperous; 2= average; 3=less prosperous*	*code*
3	How well off is your household compared to five years ago? *Codes: 1=more prosperous; 2= average; 3=less prosperous*	*code*
4	If 1 or 3: What caused this change?	*reason*

Assets

		Number of units
1	Mobile phone	
2	Radio	
3	TV	
4	Motorbike	
5	Bicycle	
6	Car	
7	Fridge	

Animals

Animal	**No.**
Cows	
Goats	

K: Interviewer opinions and follow-up

If we have more questions, would it be okay for us to come back?		*(1-0)*
End of interview		
Interviewer opinion on the questionnaire		
During the interview, did the interviewee(s) smile or laugh: Codes: 1=neither smiled or laughed (solumn); 2=only smiled; 3=smiled and laughed; 4=laughed and smiled frequently.		*code*
How would you consider this households situation compared to others in the area? Codes: 1 = worse off; 2 = average; 3 = better off		*code*
How confident are you about the quality of information given by the household? Codes: *1* = poor; 2 = reasonably confident; 3 = very confident	If poor, please give a reason and state areas of main concern:	*razão*
Notes and additional qualitative questions:		